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Role of the user in value creation on digital platforms: A case study in the real estate and construction industry

Master's thesis submitted in partial fulfilment of the requirements for the degree of Master of Science in Technology.

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Abstract of master's thesis

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Abstract

Fast-developing technology and digitalisation have disrupted and transformed many industries, while leaving others behind in the revolution. One example of the latter is the construction industry, which has only recently started to acknowledge the opportunities of digital tools and platforms provided by technology as part of its business processes. The real estate industry is slightly ahead of the construction industry on this, but still lagging compared to other industries. However, the construction and real estate industry is catching up with innovation and new technological solutions. Digital platforms enabled by advanced technology have an impact on business models of companies by changing the traditional ways of working. In order to take in the benefits provided by digital platforms, the companies in the construction and real estate industry need to understand the policies of the platform ecosystem and who are the actors on them.

Several scholars have studied platforms and their ecosystems, but only a few in the context of the construction and real estate industry. A few studies have addressed the roles of platform actors; none focused solely on the role of the platform user. Furthermore, terminological inconsistencies related to the role of the platform user were found in the existing literature. Therefore, the purpose of this research is to provide a more comprehensive description of the user role on digital platforms, to refine the concept, and to characterise users from the construction and real estate industry. In other words, the research problem is to determine the role of the platform user. This is approached using two methods: a literature review and an empirical study consisting of a survey and workshops. Due to the scarcity literature on platform user, the literature review explores studies from different areas to form the basis of the user concept. I then propose the user framework derived from the literature which consists of six user roles; freemium users, premium users, user-complementors, owner-users, lead users and innovation users. The group of potential future platform users are excluded due to the fact that the role is rather related more to mature platforms, and the present research focuses more on early-stage platform development. The empirical study addresses the current state of the construction and real estate industry regarding digitisation, digitalisation and platformisation. Finally, the user framework is tested against the empirical findings.

This research shows that the role of platform user is multidimensional, and it depends on the business principles of the platform. The empirical findings mainly support the proposed user framework, although there was no evidence for a distinction between the roles of owner-user and the owner. Both roles use the platform data to enhance the platform performance. Therefore, the role of owner-user is replaced by the role of the owner and the rest of the roles in the framework remain unchanged. User roles are made up of several characteristics, and these may be taken on to a lesser or greater extent by other roles. So, users can have elements from other roles, or they can have hybrid roles, but in all cases, one role is dominant for a particular user.

Keywords digitalisation, digital platform, platform user, value-creation, user value

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Tiivistelmä

Nopeasti kehittyvä teknologia ja digitalisaatio ovat jo vaikuttaneet ja muuttaneet monia eri liiketoiminnan aloja. Jotkut toimialat ovat kuitenkin jääneet jälkeen kehityksestä. Yksi näistä on rakennusala, joka on vasta hiljattain havainnut teknologian ja digitalisaation tarjoamat työkalut ja niiden potentiaalin osana liiketoimintaprosesseja. Vaikka kiinteistöala on hieman rakennusalaa edellä teknologian kehityksessä ja käyttöönotossa, se on silti jäljessä verrattuna moniin muihin aloihin. Rakennus- ja kiinteistöala ovat nyt ottamassa kiinni tätä etäisyyttä uusilla innovaatioilla ja teknologisilla ratkaisuilla. Kehittyvä teknologia on lisännyt alustojen käyttöä osana liiketoimintaa, mikä on vaikuttanut yritysten liiketoimintamalleihin ja muuttanut perinteisiä työskentelytapoja. Jotta rakennus- ja kiinteistöala voisi kehittyä ja ottaa entistä enemmän käyttöön digitaalisten alustojen tarjoamia hyötyjä, tulee yritysten ymmärtää alustan toimintaperiaatteet, ekosysteemi sekä sen osapuolet.

Useat tutkijat ovat tutkineet alustoja ja niiden ekosysteemejä, mutta vain harva näistä tutkimuksista sijoittuu rakennus- ja kiinteistöalalle. Vain yksittäiset tutkimukset käsittelevät alustalla toimivia rooleja, eikä yksikään näistä tutkimuksista keskity pelkästään tutkimaan alustan käyttäjän roolia. Kirjallisuudessa on myös havaittavissa epäjohdonmukaisuuksia roolikäsitteiden käytössä. Täten, tämän tutkimuksen tarkoituksena on täydentää käyttäjän määritelmää digitaalisilla alustoilla ja tunnistaa käyttäjiä rakennus- ja kiinteistöalalta. Toisin sanoen, tutkimuksen tavoitteena on määrittää käyttäjän rooli alustoilla. Tutkimusongelmaa lähestytään kahdella menetelmällä: kirjallisuuskatsauksella sekä kyselystä ja työpajoista koostuvalla empiirisellä tutkimuksella. Koska kirjallisuutta alustan käyttäjästä on löydettävissä vain vähän, perehtyy kirjallisuuskatsaus myös muiden alojen kirjallisuuteen. Tämä mahdollistaa sen, että käyttäjän roolille voidaan paremmin luoda pohja ja esittää se viitekehyksessä. Viitekehys muodostuu kuudesta käyttäjän roolista; freemium-käyttäjät, premium-käyttäjät, rikastuttajakäyttäjät, omistajakäyttäjät, edelläkävijäkäyttäjät sekä innovaatiokäyttäjät. Käyttäjäryhmä, joka jätettiin viitekehyksen ulkopuolelle, oli alustan potentiaaliset käyttäjät tulevaisuudessa. Nämä käyttäjät liittyvät enemmän kypsempään ja kehittyneempään alustaan, kun taas tämä tutkimus keskittyy lähinnä alustan kehitykseen sen alkuvaiheessa. Empiirinen tutkimus kartoittaa alan nykyistä tilaa digitisaation, digitalisaation ja alustatalouden näkökulmasta. Lopuksi tutkimuksen työpajojen tulokset esitellään ja sovelletaan viitekehykseen.

Tutkimus osoittaa, että alustan käyttäjän rooli on moniulotteinen ja riippuvainen alustan liiketoimintaperiaatteista. Tutkimuksen empiiriset tulokset tukevat suurimmaksi osaksi kirjallisuudesta johdettua viitekehystä, mutta omistajakäyttäjän rooli havaitaan olevan lähellä alustan omistajan roolia. Tästä johtuen omistajakäyttäjän rooli korvataan omistajalla ja muut viitekehyksen roolit pysyvät muuttumattomana. Käyttäjän roolit koostuvat useista eri piirteistä, josta jotkin voivat olla voimakkaampia kuin toiset. Roolissa voi olla ominaisuuksia tai piirteitä muista käyttäjän rooleista tai se voi olla niiden yhdistelmä. Kuitenkin, yksi rooleista dominoi muita.

Avainsanat digitalisaatio, digitaalinen alusta, alustan käyttäjä, arvonluonti, käyttäjä arvo

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So needless to say, I'm odds and ends, but I'll stumbling away, slowly learning that life is ok. You have taken on me and took me on, that's why you're all the things I want to remember. I am here and now because of you, you're the reason I do what I do. You were with me through the time, and you're my inspiration in life. You taught me don't give up the fight. You and I took it to the top; we gave everything we got. Thanks to you I'm a true believer and striving to achieve my dreams.

Thank you for sharing this life-changing journey with me!

Helsinki, 14.2.2019

Laura Strömberg

”Yks ryyppy, se ei oo mikkään ryyppy;
kaks ryyppyvä, se oj jo puol ryyppyvä
ja kaks puolryyppyvä se on vasta koko ryyppy.
Vallesmannin ryyppy on kaks koko ryyppyvä
ja kaks vallesmannin ryyppyvä,
se on mittarin ryyppy”.

- Elias August Piponius, 1933.

Kyseisen lausahduksen kuulin ensimmäistä kertaa fuksina killan vaihdossa ja se on jäänyt minulle erityisesti mieleen, sillä siihen sisältyy myös jatkokysymys:
”Kuinka monta ryyppyä on mittarin ryyppy?”

Kiitos killoista perhein Maanmittarikilta ja koko Otaniemi
näistä opiskeluvuosista 2013-2019.

Table of Content

List of Figures

List of Tables

1 Introduction

1.1 *Background of the research*

Fast-developing technology has taken over the traditional way of working and creating new business models in many industries. Digitalisation is changing the logic of value-creation fundamentally and disrupts all industries (Iyer and Venkatraman, 2015). Moreover, it weakens the boundaries of different industries. For example, Amazon the largest online retailer and a cloud service provider invested in a start-up that builds prefabricated houses. This strategical move enables Amazon to launch new smart home devices and install them to houses fabricated by a start-up. (Kim, 2018) In diminishing extent, industries can rely on the generic business strategies of differentiation, cost leadership and focus defined by M. Porter in order to maintain a competitive position in the market (Hui, 2014). Many industries are pioneers on the area of digitalisation, but not all have applied its affordances.

McKinsey & Company (2015) uncovers that the construction industry is one of the less-developed industries in the area of digitisation among agriculture. However, the real estate industry seems to be more advanced, as can be seen in Figure 1. (McKinsey Global Institute, 2015). According to the World Economic Forum (2015), the development of productivity in the construction industry is distinctly falling behind compared to other industries. They claim that the industry lacks innovation and collaboration, suffers from slow and inaccurate process execution and knowledge transfer between projects. Furthermore, the relatively conservative workforce towards technology in the industry has a shortage of young talents and poor people development. McKinsey & Company (2017) and KPMG International (2016) agree to the shortages of the industry, and the latter one adduces that the industry has insufficient resources and skills to analyse the data. Other explanations found for the slow development of the industry were highly cyclical markets where supply comes slightly behind of demand (McKinsey & Company, 2017).

New digital solutions have been invented to tackle project related issues. Virtual reality and new methods of simulation enable to identify conflicts and interdependencies at the design and building phases and make possible a virtual experience of unbuilt buildings (World Economic Forum, 2016). Some companies in the industry have already taken steps towards digitalisation as digital tools and applications have been utilised throughout a project lifecycle (KPMG International, 2016), but the full applicability of digitalisation is still somewhere down the road. The reason the construction industry is falling behind is that the projects are bounded to a certain place at a certain time with certain circumstances and stakeholders. Every project has its characteristics and requirements which create the complexity of the industry. (World Economic Forum, 2016)

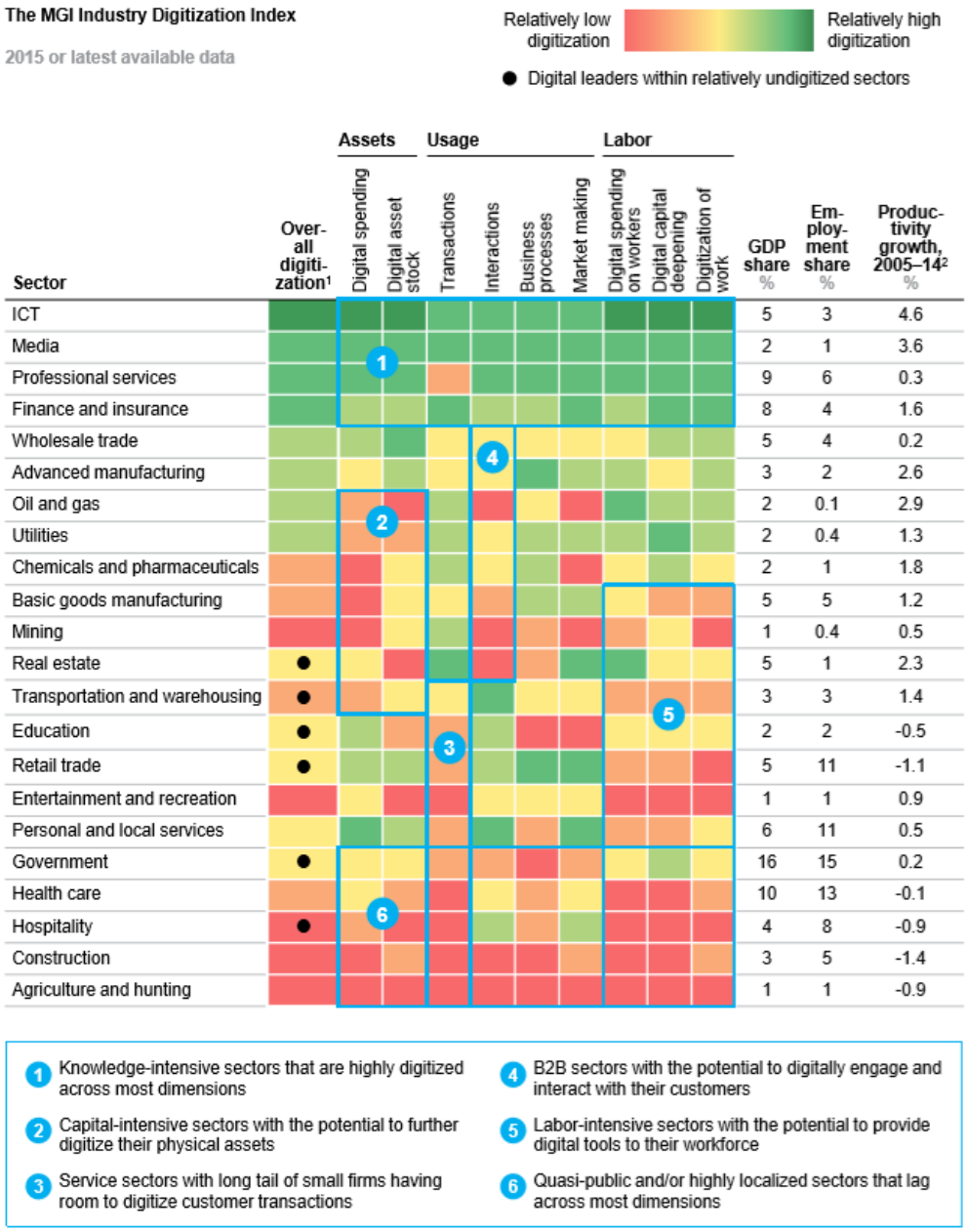

Figure 1 The Industry Digitisation Index shows the current state of digitisation in different industries (McKinsey Global Institute, 2015)

In today's world of advanced technology, information is often power and what comes to innovations, first come first served. Data is a resource that can be processed and analysed to enhance business performance or make profits by commercialising it (Thomas and Leiponen, 2016). Companies in the construction and real estate industry have acknowledged the importance of data and already taken the direction towards digitisation when slowly approaching the digitalisation. Many data-aggregating and processing tools have been invented for the industry such as Building Information Modelling (BIM). BIM is a digital project tool that manages the project information and enables project related stakeholders to collaborate and share information. BIM also represents the physical and functional characteristics of facilities (National Institute of Building Sciences, 2018). Another invention for the industry is the Internet of Things (IoT) that combines sensors, data communication devices and actuators to create an internet-based network for data collection, monitoring and process optimisation (McKinsey & Company, 2013). The Finnish

government has also recognised the changing nature of the industry and started a project called KIRA-digi in co-operation with the built environment and construction sector. The project aims to develop an open and interoperable information management system for the built environment by encouraging the companies to develop pilot projects, create new interfaces for public information and change the existing legislation to support better the digital applications and ecosystems. The project began in autumn 2016 and ended at the end of 2018. (KIRA-digi, 2016)

Recent studies, publications and the seminar of World Digital Built Environment Summit 2018 revealed that many companies in the industry seem to collect data, but only a few have intuition how to utilise it (Säynäjoki *et al.*, 2017b). The construction and real estate sector has acknowledged a need for resources and capabilities to use the available data more efficiently. Companies that are capable of collecting, analysing and integrating the processed information into their business strategy, are going to dominate the markets (Iyer and Venkatraman, 2015). To an increasing extent, companies in the construction and real estate industry need to compete with companies from other industries, such as IT-companies who have more innovative business models, platforms to operate and who have the interest to set foot in the smart building business. (Säynäjoki, Säynäjoki, *et al.*, 2017).

The increase in open innovation as a business model has created new strategies to do business and compete with other companies. The publications comprising a term of an 'open business model' have grown in number on past decade (Weiblen, 2014), and in recent years number of digital platforms has become a common practice for people such as Google, Linked In, Uber and food application Foodora. The companies are more open for collaboration with external parties than before (Osterwalder and Pigneur, 2010, p. 76-87). Platforms support this strategy by providing facilities for different parties to collaborate and share knowledge. Since the actions take place in a digital interface, much data is generated. As in any business, a customer is crucial for a company to succeed. The same comes with platforms, where a customer is a user of a platform. However, not all the data can be collected and analysed, and not all of it is valuable. To exploit the value of available data, the conservative construction and real estate industry must extend its understanding how to orchestrate the complexity of platform ecosystem, who are the actors of the platform and how to manage data. The valuableness of a platform does not base on only the data, but also the dynamics of different parties and network effects.

Since advanced technology and digitalisation has transformed many industries, there exist some publications related to digital platforms, business models, value creation and capture. The platform theory has explored in many sectors other than the construction and real estate industry, which creates a motivation to look on these topics more closely. There are not many studies that cover all the platform actors and hardly any of them specifically address the role of the user. However, significant progress in defining the roles of platform actors have achieved Gawer and Cusumano (2014) and Van Alstyne et al. (2016). In addition, Säynäjoki et al. (2017a) have studied data distribution and commercialisation in the construction and real estate sector implementing the platform actors into the context of a smart building which gives a good starting point to explore even more platforms in the industry (Säynäjoki *et al.*, 2017a). Nevertheless, the studies lack the exact definition for the platform user and scholars have used the concept in different ways depending on the context of research. The inconsistent use of the concept has caused difficulties to find a common understanding of the definition of the user concept and created a need for more in-depth research.

1.2 *Research objective and questions*

Due to fast technological development, studies of digitalisation and platforms have explored more in the past decade, but some inconsistencies were found. The existing research has focused on the value and value capture in the general level and mainly from the perspective of platform owner giving not much attention to other platform actors. Moreover, the studies of the user role and relation on platform value creation turn out to be scattered. In order to fill these gaps in existing studies, two research questions are set as follows:

1) *How digital platform literature recognises the user?*

2) *How construction professionals perceive the role of the user on digital platforms?*

The purpose of the exploration of the platform user is to extend an understanding of the role and how the user impacts on the platform value. Thereinafter, the applicability of the user framework will be evaluated on the context of the construction and real estate industry.

1.3 *Research approach*

The research questions are answered based on the existing literature and findings of empirical research consisting of a survey and workshops. The first research question addresses the multi-sided roles of the user that are determined through the literature review. The second research question explores the user roles in the construction and real estate industry which are applied to the user framework derived from the literature. The case company is a large Nordic construction company that have years of experience of all kinds of projects in the field of built environment. The company focuses on development projects. The research process is shown in Figure 2.

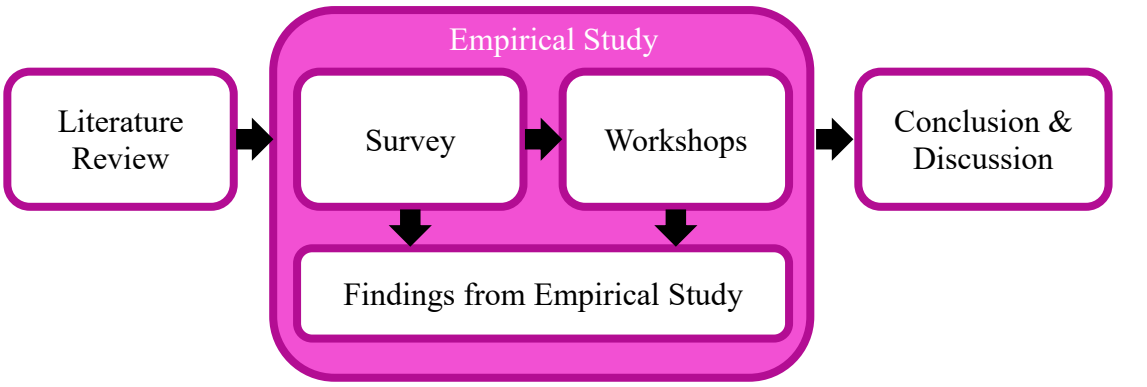

Figure 2 Research process.

The literature review includes a wide variety of different publications and online sources. Most of the scientific articles, journals and books are found through Science Direct, Google Scholar and Research Gate. Moreover, non-academic reports, web-based materials, online articles and news were added to bring more up-to-date content and plausibility to the review. The language of the reviewed literature is mainly in English but some Finnish as well. The concepts of a platform, an open business model, an open innovation, dual-sided markets, and

a platform actor-network are covered in the extent necessary for comprehending the background of the digital platforms. Few scholars have explored the platform actors and proposed four roles of the platform owner, the provider, the complementor and the user. Moreover, Säynäjoki et al. (2017a) have complemented the actor-network by sub-roles of data commercialisation. The literature review aims to provide a comprehensive theory behind the role of the platform user.

The empirical part of the present thesis is conducted by the qualitative and quantitative approach, which enable deeper insight and more comprehensive analysis to bear the existing theories in literature. The qualitative approach is recommended if the topic of the research is less well-understood or studied phenomena. The survey was a mix of the qualitative and quantitative methods, which provides a more holistic overview and understanding of the research than either technique alone. (Creswell, 2014, p. 41-48; Sutton and Austin, 2015)

The survey originates from McKinsey's maturity survey, but the questions are modified to suit better for the construction and real estate context. Additionally, sections seven and eight are added to improve the maturity model regarding data commercialisation. Almost all the questions are scored, which resulted in a score to reflect the digitisation and digitalisation level of the company. However, due to the number of questions and data of the survey, this research addresses only six questions from sections five to eight that are illustrated in Figure 3. These questions were selected according to the feasibility to answer the research questions. The respondents of the survey are chosen from the case company's employees who have a higher position and awareness of the state of digitalisation in the industry. To get a more realistic overview of the industry, the case company's subcontractors and client cities of Finland will also answer to the survey. The subcontractors include construction material and element suppliers, and component producers.

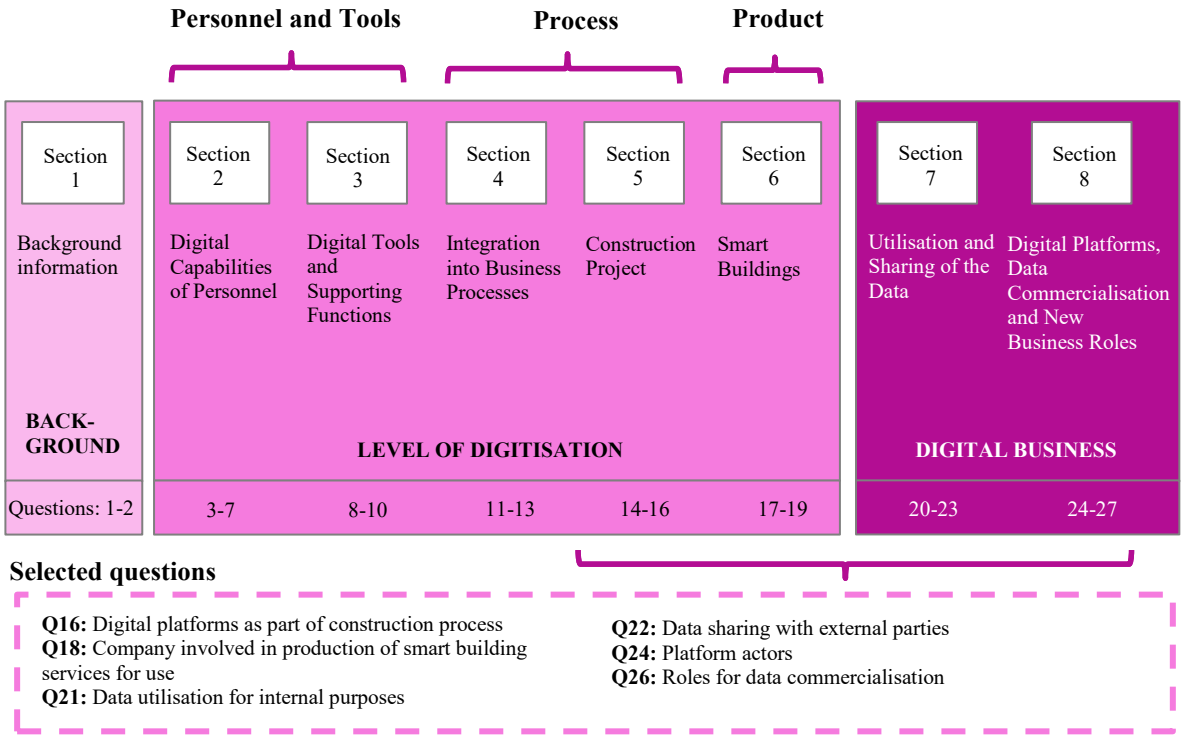

Figure 3 The structure of the survey and selected questions for the research.

The qualitative part of empirical research is implemented in the form of workshops. The participants in the workshops are employees of the case company who represent different facets, positions and units of the company. All participants possess at least the title of unit manager or higher. The reason for choosing these participants is that they are professionals from different business units and have an awareness of the problems in the construction industry and what digitalisation would provide to them. The results of the survey are presented to the participants in the workshops. The workshops focus on discussing the potential platform roles of the case company, identifying the other platform actors and determining the capabilities of the company to produce data and utilise it in a particular type of platform. The research methods of the qualitative and quantitative data analysis are described more specifically in Chapter 3.

1.4 *Research scope and limitations*

The research topic and scope are chosen based on the research gaps in the existing studies. The scope of this thesis focuses on the role of the platform user, value creation and value capture in a platform from the perspective of the platform user. Since the topic has not been studied much and not in the context of construction and real estate industry, all research decisions are made based on assumptions and supportive explanations. These make the research topic highly explorative. Therefore, it is essential to make limitations for the thesis scope.

- Lack of the context related literature and especially theory of the user role leads to an approach where the theory is applied from another area of studies.
- The survey is directed to a particular people from the case company, its subcontractors and client cities. The participants of the workshops were chosen based on their awareness of the problems in the construction industry and the possibilities enabled by digitalisation.
- The results of this study cannot be generalised for the whole construction industry since they are a snapshot of the current state of the industry in a specific country.
- The data collected and analysed is based on the year 2018 and limited to the country of Finland.

In the study, the data is collected through a survey and four workshops in order to get multifaceted data. Data from the workshops is qualitative and subjectively interpreted by the researcher. The focus of this thesis is the role of the user, the user's relation to platform value and then finding potential user roles in the construction and real estate industry.

1.5 *Research structure*

The thesis consists of five chapters depicted below in Figure 4. The first chapter is the introduction to the background and the topic of the research including research questions, objectives, scope, methods, limitations and the structure of the study as well as defining concepts of *"digitisation"* and *"digitalisation"*.

The aim of the second chapter is to provide a deeper understanding of the topic and present a theoretical background. The chapter reviews the literature covering the main concepts around the topic that are platform business models, open innovation, the network of actors on the platform, the current and new roles of the user as well as value creation and value

capture from the perspective of the user. The definition of the concept of the platform user is determined by exploring the existing and available studies on the topic including marketing, service, business and innovation literature. Finally, the chapter proposes the platform user framework.

Chapter three describes the methods used in data collection and explains the reasoning behind the selection of applied data sources. The chapter introduces the participants of the survey and workshops as well as covers the themes of the workshops and the survey technique.

The fourth chapter reports the results of the empirical study and presents the relations between the results and the theory from the literature. The objective of this chapter is to evaluate the applicability of the user framework in light of empirical findings.

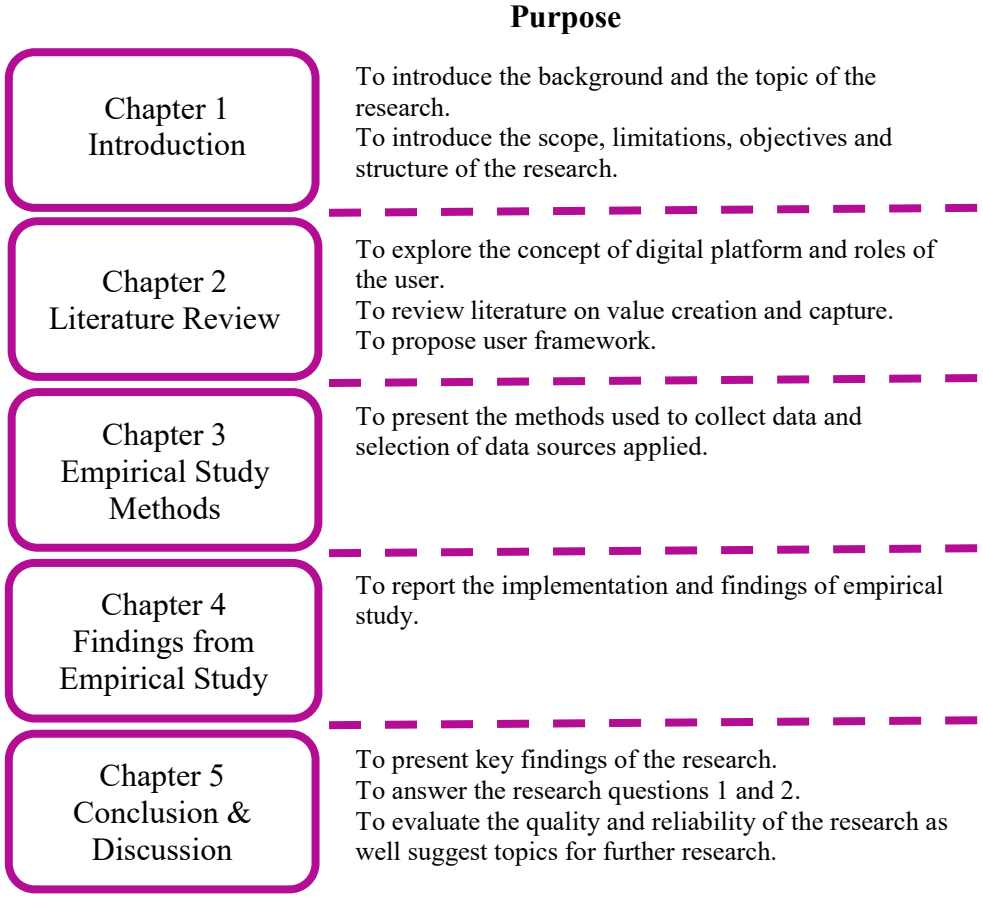

Figure 4 Research structure.

The last chapter summarises the research, presents the key findings from the empirical study and provides the final answers for both research questions shortly. Firstly, the user framework introduces the different roles of the user. Secondly, the applicability of the framework is evaluated against the user roles identified in the construction and real estate industry. Lastly, the chapter provides a discussion of research quality, reliability and the applicability of the framework as well as proposes recommendations for further research.

1.6 *Definitions of the main concepts*

Since the present thesis discusses a topic which is not that familiar to the construction and real estate industry, the main concepts are defined to provide better competency to understand this research.

Digitisation – Digitisation is a process of converting existing analogue streams of information into a digital form, which is also known as digital enablement. For example, transforming images, sounds or texts into digital bits. (Praprotnik, 2016; The Oxford English Dictionary, 2018)

Digitalisation – Digitalisation refers to a process of recording, transferring and analysing the data and information in digital form. However, the concept points broadly to the process of economic and social change resulting in development of information and communication technology. (Koistinen-Jokiniemi *et al.*, 2017)

2 The literature on digital platforms and actors

This chapter reviews the literature by providing more in-depth understanding and overview of digital platforms, its actors and value creation through a theoretical review. Additionally, the chapter presents a framework for the platform user.

2.1 *Digital platforms*

Platforms have become more common in the past years, and they have also become part of people's everyday life. The platform concept is radically transforming businesses, the economy and society. As has already happened in many other industries, the platform revolution is soon shaking also the construction and real estate industry. This section reviews the paradigm and function of the platform as well as introduces the primary stakeholders on digital platforms.

2.1.1 Two-sided markets and multi-sided platforms

One of the most remarkable invention in the field of financial services has been the establishment of the credit card system, which connected consumers and traders giving a fire start to two-sided markets (Eisenmann *et al.*, 2006). The two-sided markets have two agents and the intermediary or platform serving the agents. The externality or interdependence between the agent groups such as the number of agents in one agent group or the price sensitiveness affects the choices of intermediary. (Rysman, 2009) In the environment of the two-sided market, the agent groups pursue to exchange the values through a fair transaction.

Game console producers such as Sony, Microsoft and Nintendo are great examples of two-sided platforms. The main actors are the manufacturer of the console, gamers and game developers. Two agents which are in this case the gamers and game developers interact through an intermediary that is the console manufacturer. (Osterwalder and Pigneur, 2010, p.82-83) The console must perform well by technical features such as graphics and processor speed. Furthermore, the price needs to be reasonable, and it has to have a sufficient number of interesting games to attract gamers. Then again, the console needs to have gamers to attract game developers. The decision of both agents influences the outcome of another agent which is also known as a network effect. Besides console sales, the console manufacturer produces its own games and collects royalties from developers to cover the hardware sales at a loss. While Sony and Microsoft competed with expensive features, Nintendo offered a Wii console for casual players with a new physical feature. Wii enables gamers to play games with remote control and detects movement. The main difference between Wii and Sony/Microsoft consoles is that Wii earns both console sales and royalties. (Eisenmann et al., 2006; Rysman, 2009; Osterwalder and Pigneur, 2010, p.76-87)

Multi-sided platforms are also known as multi-sided markets by economists. The primary function of a platform is to attract and serve all groups of agents in the platform simultaneously to produce value. At the same time operators of multi-sided platforms need to ensure a sufficient amount of revenues and identify the price-sensitive side of the platform. Multi-sided platforms have two or more customer segments, and each of them has their own value proposition and revenue stream. (Osterwalder and Pigneur, 2010, p.76-87) These multi-sided markets stimulate external innovation, whereas the platform of two-sided markets facilitates trade and not allow other players to innovate complementary assets

(Gawer and Cusumano, 2014). The value proposition can attract users to use the platform, contribute to matchmaking between user groups, promising to solve customers' problems and satisfy their needs. Revenue stream can be for example getting free offers or price reductions that are targeted to a specific customer group. However, there is always someone who needs to be the one to pay, because money makes the world go round. (Osterwalder and Pigneur, 2010, p.76-87)

Google is an excellent example of a platform which gathers revenues only from one segment of customers, advertisers while offering a powerful searching engine and a bundle of tools (Gmail, Google maps, Drive, Picasa) free of charge for platform users. These users are consumer customers who are Web surfers and content owners. Google's cash flow comes from the advertisers through bidding on ad-related keywords or search-terms that they get their adds more visible. Third parties can take a share of Google's revenues by allowing Google's ads to appear on their websites. A large number of users makes the platform attractive to advertisers, whereas users are attracted to free applications and benefits offered by platforms. (Osterwalder and Pigneur, 2010, p.76-87)

Digital and non-digital platforms differ slightly from each other, but platforms can also be hybrid. Compared to digital platforms, non-digital platforms do not have an extensible codebase and technical elements such as software or hardware that supports platform operations. Therefore, non-digital platforms face challenges in a changing environment (Reuver *et al.*, 2017). Digital technologies necessitate homogenisation and distribution of data, re-programmability and editability (Kallinikos *et al*., 2013). These can lead to a confusion of ownership of platform core and who says the last word. The platform needs to be stable but the same time flexible for changes, such as the increase of platform users or software updates. The application programming interfaces enable complementary products or apps to be developed afterwards into the existing digital platforms whereas this would not be as easy with physical products. (Reuver *et al*., 2017) The digital platform consists a codebase of a software-based system providing core functions which are shared by the interoperating modules, that are often developed by third-party developers, and the interoperable interfaces (Tiwana *et al*., 2010; Reuver *et al., 2017)*. Lastly, the openness of the digital platform relates to the organisational arrangements such as rules of entrance and exit as well as to openness of technology for third-party complementaries like application programming interfaces and development kits. (Reuver *et al*., 2017) The digital platforms bear complexity and composing the boundaries to the ecosystem can be difficult. However, digital platforms are adaptable for changing requirements which make them significantly more durable compared to non-digital platforms.

2.1.2 Platform business models

The purpose of a business model is to describe the organisation's policy to create, deliver and capture value. In open business models, the value is created and captured by systematically collaborating with external partners. A company can put external ideas to use internally, or the company can provide their own ideas for external parties. (Osterwalder and Pigneur, 2010, p. 108-111) Chesbrough (2006) regards that in the environment of shared knowledge, the companies could create more value and broaden their ideas by integrating external knowledge and products into their own business innovation process. To success in the current environment, a company need to innovate openly, not only produce new ideas to enhance the product performance but concentrate more on the business model, value creation

and value proportion. Another concept that is strongly related to platform ideology is open innovation. Open innovation denotes sharing the ideas externally, reaches the markets faster with shorter product lifecycles, has an opportunity to share risks and lowers the costs of innovation. (Chesbrough, 2006, p. 1-21) Chesbrough proposed a "not invented here" syndrome to describe the internal resistance of a company against external innovations and technologies. The attitude originates from a lack of trust of external practices and ideas and questions the implementation to the internal use. Another reason for rejection is risk management which the external technology would cause if it fails in use. (Chesbrough, 2006, p. 21-26)

Platforms create value through different business models, design and strategies where a central feature is the network effect. A platform strategy can be based on the level of openness of the platform, pricing and attracting or limiting the volume of the users or the number of complementary asset providers (complementors). Moreover, companies are facing a tough decision; should they settle for the current situation or go out on a limb, where the possible fruits are. Investing in innovation and research always contains risks, but it can be very profitable when it comes to success. (Rysman, 2009) Evans and Gawer made distinctions between platforms and categorised them into four platform types: innovation, integrated, investment and transaction. (Evans and Gawer, 2016)

Innovation platforms are open to external companies' or complementors' products. The platform has been founded on technological building blocks of which the third parties can develop complementary products. Complementors of the platform create an innovation ecosystem. The owner of the innovation platform does not need to determine in advance who the third party complementors for the platform would be. The openness of the platform attracts and encourages the complementors to join. (Evans and Gawer, 2016) Companies like Windows, Google or Apple, provide this kind of innovation platforms where they provide besides their own products the services and products from complementors.

Evans and Gawer (2016) proposed a transaction platform as a technology, service or product which intermediates the exchange or transaction between the platform actors, such as users, buyers or suppliers. Wismer and Rasek (2017) regarded that the transaction platform can be divided into two types of platforms. In addition to the fact that they agreed to the definition proposed by Evans and Gawer, they denoted that the direct transactions take place between two separated customer groups with the aim of accomplishing the transaction. The object of the transaction can be for example a service or product. The main distinction to the non-transaction platform is that one customer side would not be enough for the platform service and the platform requires multi-sidedness to perform better. (Wismer and Rasek, 2017) Well-known examples of transaction platforms are Amazon, Airbnb and Uber.

A non-transaction platform intermediate different interaction and do not necessarily cause a positive network effect between two agents. There is not always needed interaction between the agent groups, and the platform can also start operating with one agent group. Another agent group can be added later or not needed at all. For example, a newspaper can obtain a wide audience by serving interesting editorial content and subsequently providing the platform to advertising agencies. It is a company's strategic decision to choose if its function is to serve only one of the customer groups. (Wismer and Rasek, 2017)

Last business model platform is an integrated platform where two platforms are integrated. For example, innovation and transaction platform that produces a product or service, such as Apple. They have both a platform the App Store and a large number of third-party developers. Investment platforms are developed to support the company's platform portfolio strategy, and they may act as a holding company or an investor, or both. (Evans and Gawer, 2016) For example, SoftBank has bought a majority share of Supercell, a finish game manufacturer, and owns shares of various other companies (SoftBank Group, 2018).

2.1.3 Value on a digital platform

While traditional pipeline companies create value through a classic value chain model (e.g. controlling linear series of activities that increase the value of the product), platform create value in its ecosystem (Van Alstyne *et al.,* 2016). Recently, even more companies are shifting their business structures from a simple pipeline structure to a platform structure with complex relationships (Parker *et al.*, 2016, p. 5-7). Van Alstyne et al. (2016) proposes that the business can be both – pipeline and platform – like Apple's handset business combined with the App Store. A pipeline business has quite easily imitable tangible and intangible assets while the platform's community and the contribution of the ecosystem are harder to copy. However, the complementors and customers (the platform users) can disappear if a superior platform appears to the market. Platforms can unlock new value creation sources and supply channels. Moreover, platforms can easily scale the business borders and create value feedback loops with digital tools while pipeline businesses cannot. Every platform attracts a different kind of users, operates differently and creates different forms of value, but the fundamental elements are the same in every platform business. (Parker *et al.*, 2016, p. 5-10)

Value through interactions

As presented in the previous section, a platform strategy links to the open business model. The foundation of the open business model is systematically collaborating with internal and external parties of the company. The key is to share knowledge, bring new external ideas to the company's practice and in that way co-create value through interactions. (Chesbrough, 2006, p. 109-111) Platform creates value by facilitating and supporting interactions between different parties in set governance conditions. The purpose of policies is to create and sustain a vibrant platform ecosystem ensuring value creation and high-quality participation. In the value creation process, actors of the platform can exchange, consume and co-create value. (Evans and Gawer, 2016; Parker *et al.*, 2016, p. 5-7)

Platform ecosystem actors can also influence the platform value through their actions. Like in the example of a Nintendo console, the owner of the platform needs to find a critical number of users and game developers need to make the business succeed. The owner of the platform can affect the number of users by attracting them with incentives (Rayskin, 2017). Rayskin (2017) studied the user dynamics from platform owner's perspective exploring what number of users would be most beneficial for the platform development process and in other stages of growth to succeed (Rayskin, 2017). According to Metcalfe's law, the value of a network grows nonlinearly when the user volume increases resulting in more connections among users (Parker *et al.*, 2016, p. 297). However, the impact of the number of participants on the value of ecosystem should not be overemphasised, as the quality of the participants is also essential (Evans and Schmalensee, 2016, p. 29-30). Some types of consumers or complementary asset providers are more valuable than others which generates a need to

subsidise actors when seeking the most valuable ones in order to maximise the platform value created in interactions between participants. (Van Alstyne *et al.*, 2016)

Platform network effects

Besides a business model and strategy, a platform creates value through network effects. Network effects take place between two or more agents, and they can be positive or negative effects. These network effects create a business ecosystem, which in turn contributes to innovation and value. The increasing number of individuals in the agent group makes it more or less valuable to the agents in the same group. For example, if friends of yours are starting to use Facebook, the more attracting it becomes for you to join. This phenomenon is called a same-side effect. In a cross-side effect, the increasing number of individuals in one agent group influences on the valuableness of the platform to the agents on the other side. The growth on one side can accelerate the growth on another side of the platform and in the best-case scenario, the growth will be exponential instead of linear. To trigger the network effect, first the chicken and egg problem need to be solved. The platform needs the complementary asset producers to attract users and users to attract complementary asset providers, like in the example in section 2.1.1 which concerns the console's game developers and gamers. Moreover, the new entrants of complementary asset providers are not willing to step into the market where a large number of existing producers make the market seem less appealing. (Halén *et al.*, 2016) The same-side network effects are generally negative while the cross-side effects are more often positive. (Eisenmann et al., 2006)

Some academics categorise the network effects into direct and indirect effects, and some of the academics even refer them as synonyms for same-side and cross-side network effects (Helfat and Raubitschek, 2018). In the present research, the concepts are regarded as distinct since direct and indirect effects are seen to be related more to value chain. For example, the utility of phone depends on the amount of people you can call that is called a direct effect (Halén *et al.*, 2016). The number of users can also overload the platform when there is not enough capacity and may result in operating problems (Halén *et al.*, 2016). The indirect effect occurs for example when there is a high demand for the platform services or products; the other parties have the interest to enter the platform or improve the platform quality. The demanding party makes the platform more valuable for other parties such as customers of Uber. (Reuver *et al.*, 2017)

Value failures

While the aim is to identify the positive network effects, the negative effects should not be ignored. As technology evolves, the number of opportunities to invest and expand the scope of the platform by integrating it more widely into complementary markets appears. This may create disincentives for the platform complementary asset providers to invest in new products and services in the same markets. (Gawer and Cusumano, 2014) Additionally, complementors, users or owner of the platform may cause negative effects by producing abusive, offensive or low-quality content, misbehaving or spams. Fake or scam profiles reduce the reliability and attractiveness of the platform. Thus, the quality of platform data also influences the valuableness of the platform. (Van Alstyne *et al.*, 2016)

Other effects that extract platform value are failures and spillovers introduced by Van Alstyne et al. (2016). If the platform performs poorly and fails to meet the needs of its users, the users may defect to another platform which responses to their needs better. For example, the Uber ride itself is valuable for both the customer and the rider, but if there are not enough

Uber drivers for customers and it takes a long time to get a ride, the customer is more likely to take a taxi. Customers who often see a message "not available" or undergo disappointments regarded to the service will stop using the platform. The openness of the platform is usually beneficial by stimulating network effects and value creation, but it can also fail due to bad orchestration. The unfettered access to the platform and defective platform rules, as well as control, can be harmful. A company named Chatroulette provides an online chat platform that pairs its users randomly around the world allowing the user to message and video chat. Due to its openness, new misbehaving users such as "naked hairy men" appeared to the other side of the webcam decreasing the number of cloths on users. The company responded to the problem by reducing its openness. (Van Alstyne *et al.*, 2016)

Value capture

As discussed, many ecosystem factors affect to value creation on a platform. However, how the value can be captured? Parker *et al.* (2016, p. 110-111) presented four forms of value "sources of excess value" that need to take in consideration when creating a strategy for capturing the value and monetisation. Platform creates value for users, i.e. consumers by giving access to the value created on the platform, as videos on YouTube. The third-party providers get value from access to a new market, like Airbnb hosts and travellers, or a community like LinkedIn where recruiters and job-seekers find each other.

Additionally, the tools and services of the platform enable interaction between users and complementary product or service providers. eBay and PayPal together provide a fully functioning global marketplace where anyone can start their own business and sell products. Finally, the curation mechanisms of platforms enhance the quality of the interactions. The user values offerings that meet his needs such as high-quality or unique products and provider values the user who is willing to pay a fair price. When the businesses of complementary product and service providers are doing well, they are more committed to staying on the platform. (Parker *et al.*, 2016, p. 110-111) Another question that needs to take into consideration when creating a monetisation strategy for a platform is who should be charged? Platforms can offer free or subsidised pricing to one participant group while another group pays full price which makes the platform monetisation model more complicated. When giving away value to one side, the value needs to be captured other side. (Parker *et al.*, 2016, p.109-111)

Network effects measured by the number of platform participants alone do not necessarily reflect the platform's monetary value. The facilitated interactions must generate excess value that can be captured by the platform without generating a damaging impact on the network effects. Otherwise, the monetisation of network effects might be impossible. Moreover, in some cases, negative network effects can impact on platform value positively as the value increases when the number of users declines. This phenomenon indicates that the relationship between the monetary value of the platform and network size is paradoxical. It is important to decide who takes the role of a payer and who enjoys the value for "free" in exchange for joining on the platform. Platform needs to encourage desirable interactions and discourage undesirable ones, and monetisation mechanisms are one way to do it. (Parker *et al.*, 2016, p. 112-115)

As introduced, the excess value created by the platform –access to value creation, to the market, to the tools and curation – can be monetised effectively by using different strategies. The value created by network effects can be monetised for example, by setting an access fee

for its users and complementors or charging a small fee every transaction made on the platform. The transaction fee can be fixed or some percentage of the transaction price, but then again an access fee discourages participants to join the platform reducing the volume of interactions and available data. Without users, the complementary product or service providers are not interested in joining the platform either. Instead of charging participants a subscription fee, the platform should subsidise the participation. (Parker *et al.*, 2016, p. 107-108) Therefore, the transaction-based charging is more negligible for platform participants, i.e. sellers and buyers, since the interaction and actual transaction already occurs.

On the transaction-based charging strategy, the platform owner needs to be careful that the parties are not able to make the transaction off-platform after finding each other. Sometimes retaining the control over communications between the service provider and the user is not possible, and the strategy does not work. The communication between the parties happens most often on platforms where the object of transaction requires discussion, exchanges and workflow management. Parker et al. (2016, p. 115-122) present that a platform owner can prevent the off-platform transactions by providing tools and integrated services to monitor the service provider during the delivery process and creating an environment for a safe transaction, like payment and invoice services. Third-party service providers can be charged for access to the user market of the platform when users have free access that attracts users to join. For example, Dribble is a community platform for designers where they can present their work. The cloth companies are interested in new talents, and therefore, they are charged for access and posts of employment listings on the site. Additionally, a platform can offer to complementary asset providers enhanced access, such as better targeted messaging, promote visibility of posts or interaction with particularly valuable users, for a fee. Sometimes platform content can become overwhelming to their users who cannot find quality content anymore and reduces the value of the platform. At this point, the user is willing to pay for access to content that is quality guaranteed. (Parker *et al.*, 2016, p. 115-122)

Due to the fact that activities, interactions and co-creation between actors take place in a digital environment, then also digital marks are left to the platform system, e.g. data. By creative thinking, the data can be used to create value for platform participants. Such as providing transaction-related data that complementors may use to improve their businesses, showing product reviews and enabling product or service comparisons for the user. (Parker *et al.*, 2016, p.109-111) The platform generated data such as data from users can be sold to third parties or used to benefit the platform, i.e. improve platform's functionality, service concepts, price optimisation or identify most crucial value sources (Lee *et al.*, 2017; Ruutu *et al*., 2017)

Parker *et al.* (2016, p. 111) argue that well-designed platforms create much more value compared to the captured value which attracts more participants since they enjoy the benefits of the "free" value generated by the platform. Several real-world platforms founded begun to offer their services for free and encouraged users to join. Later when a unit of value has been created, and both the service provider and user are satisfied with the exchange, the platform owner seeks a way to capture a share of that value. Myspace is an example of doing the opposite causing a backfire and its users to disappear. (Parker *et al.*, 2016, p. 125) Thus, recognising the sources of value generated by the platform is essential, and it is essential to capture the value adequately that the platform will succeed in the long run. Monetisation strategies are complicated and can affect the viability of the platform. The monetisation

strategy needs to be planned carefully without harming the network effects: who takes the role of payer and who the role of free rider.

2.1.4 A network of actors on a digital platform

One of the success measurements of the platform is how well the platform attracts other parties to join and operate as a part of the platform. Platform with strong networks can restrain the external market of the platform as well as limit the number of new entrants. When the platform is open for third parties (e.g. Complementors), the new products and applications combined with the platform create more value to the customer. Moreover, this generates more profits for the platform owner and the owners of the main complementary products. (Halén *et al.*, 2016)

The platform consists of a broad network of actors interacting with each other through the platform. Due to the novelty of the platform ecosystem theory, there are no established consistent terms for actor roles in literature. However, platforms have the same basic ecosystem structure comprising almost similar actors across the scarce literature on the topic. The terms for actors found in the literature are presented in Table 1.

Eisenmann et al. (2008) proposed a platform network of four actors: demand-side users (for example consumers), supply-side users (for example developers), platform provider and platform sponsor. Besides including demand-side users into the framework, Gawer and Cusumano (2014) presented an idea of an external platform in which they replaced platform sponsor with platform owner and supply side users with complementors leaving out the role of the platform provider. Another version of actor-network introduced by Van Alstyne et al. (2016) providing more specific descriptions to both users in demand and supply side naming them as producers and consumers. Additionally, they replaced the role of the platform sponsor with the owner of the platform. Van Alstyne et al. (2016) also stated that in some cases the user and the complementor might switch places with each other. Both Eisenmann et al. (2008) and Van Alstyne et al. (2016) included the role of a platform provider into their frameworks.

Säynäjoki and Pulkka et al. (2017) developed the framework even further to be suitable in the context of construction and real estate sector (Pulkka *et al.*, 2016). They chose smart buildings as a platform and perceived IoT-solutions and technical systems as providers of platform seeing them be part of smart buildings. Nevertheless, the framework contained the same three actors as Gawer and Cusumano (2014): users, complementors and platform owner. Similarities can be seen between these frameworks, and four main actors can be identified to constitute the network of actors: platform owner, provider, complementor and user. The list of main actor roles and their synonyms in literature are presented in Table 2. Furthermore, Thomas and Leiponen (2016) proposed six sub-roles for data commercialisation and value creation, which Säynäjoki et al. (2017a) integrated as part of actor-network in the context of smart buildings. The four main roles and their sub-roles are introduced hereafter.

Table 1 Platform actor role synonyms on literature.

Role	Synonyms
Platform owner	Orchestrator (Manikas and Hansen, 2013; Christensen *et al.*, 2014) Platform sponsor (Eisenmann *et al*., 2008), Platform leader (Gawer and Cusumano, 2014)
Platform provider	Platform vendor (Mazhelis *et al.*, 2012)
Complementor	Supply-side user (Eisenmann *et al.*, 2008) Producer (Van Alstyne *et al*., 2016) External developer (Manikas and Hansen, 2013) Application developer (Eisenmann *et al.*, 2006, 2008; Tiwana, 2014) Complementary service provider (Mazhelis, Luoma and Warma, 2012) Third party organization (Hanssen, 2011) Niche player (Manikas and Hansen, 2013; Christensen *et al.*, 2014)
User	Demand-side user (Eisenmann *et al.*, 2008) Customer (Rayskin, 2017; Säynäjoki *et al.*, 2017a) Consumer (Van Alstyne *et al.*, 2016) End user (Hanssen, 2011; Christensen *et al.*, 2014; Tiwana, 2014) Buyer (Eisenmann *et al.*, 2006, 2008; Reuver *et al.*, 2017; Wismer and Rasek, 2017)

Additionally, actors giving up something and receiving something in return can be referred to an exchange economy. Eisenmann et al. (2008) suggested that value generated by actors in a platform to one another create value streams which take place between the actors. Gawer and Cusumano (2014) presented that value is created through innovation and via network effects. Furthermore, they stated that when setting the openness level of the platform, the owner should also preserve some source of revenue and profit. Finally, Van Alstyne et al. (2016) disclosed that the network has both value and data exchange streams which flow through the platform from the producer side to the consumer side and vice versa.

On the middle of streams, there is a platform with actors of owner and producer who also benefit and give input to these streams. Säynäjoki et al. (2017a) left out value stream from their framework including only data and information to be exchanged between actors. However, it is remarkable that they presented the same flow structure than Van Alstyne et al. (2016) which does not run directly from one actor to another without running through the platform. Based on the literature, the value and data streams can be regarded as essential parts of the platform network. Although revenues and profits were also proposed as one of the factors of the platform ecosystem, they were not included in other studies than Gawer and Cusumano (2014). In reality, there exist cash flows. For example, a platform can charge users for subscription fees; the owner can earn revenue from third-party ads or royalties from complementors, and complementors may charge users from using their complementary assets. Therefore, there are streams of value, data and cash on a platform ecosystem. The streams, the network of actors on a platform, the network effects and the sub-roles of the actors on data commercialisation are illustrated in Figure 5.

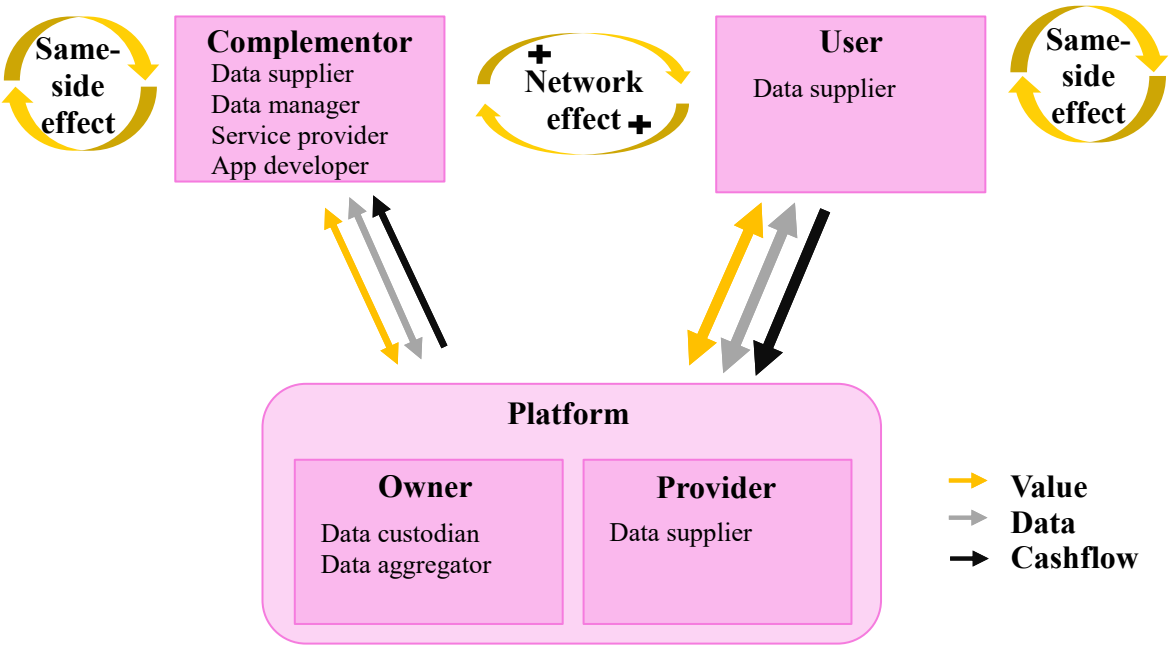

Figure 5 A network of actors on a platform ecosystem.

Owner

Owner of the platform is responsible for controlling intellectual property and governance (Van Alstyne *et al*., 2016). The platforms give their owners power to make critical strategic decisions and challenge them to rethink the business model, leadership and what are the approaches to produce and capture value. The owner decides how open is the platform and what are the rules that apply to other actors on the platform. Open architecture allows complementors to join the platform with new products or services that create new sources of value. Open governance let the other actors shape the trade rules and share the rewards. Without a fair reward system, the platform lacks an incentive for complementors. The pressure of competition and changing market force owners to innovate and develop the business model. (Evans and Gawer, 2016; Van Alstyne et al., 2016) With openness, the owner can stimulate the innovation of its complementors (Gawer and Cusumano, 2014).

The owner has the best opportunity to create and capture value on a platform usually having control over the platform memberships and critical sources of data (Säynäjoki, Pulkka, *et al.*, 2017). The owner can also obligate other actors to pay compensation of right to use the platform or provide freemium and premium versions of the same service (Evans and Gawer, 2016; Thomas and Leiponen, 2016). To success, the owner must have a vision beyond one's own business, objective to assemble sustain and strong network of partners as well as support the positive cross-side network effects (Helfat and Raubitschek, 2018). The owner must set the relationship balance between complementors and competitors. Furthermore, the owner needs to be aware that the company is vulnerable to the innovation of its complementors, competitors and wannabes. (Gawer and Cusumano, 2014) The owner can choose to recruit complementary asset developers or develop also own complementary products or services for the platform (Helfat and Raubitschek, 2018). Evans and Gawer (2016) used the term "a platform leader" to describe the owner. They stated that the leader also needs to maintain some level of neutrality and complaisance over the partners. Altogether, the owner decides the rules of the platform (e.g. who can participate in the platform's operation and how) and holds rights of a platform's intellectual property. The owner has great power and

responsibility of data which have an impact on what kind of horizon is there ahead for the platform.

In data commercialisation, there are two additional roles important for the platform owner regarding value creation: data custodian and data aggregator. A data custodian controls access to data, supervises the quality and monitor the accuracy of data. (Säynäjoki, *et al.*, 2017) The data custodian is responsible for establishing trust in the platform, implementing business rules and maintaining privacy which enables secure reuse and resale of data (Thomas and Leiponen, 2016; Carnegie Mellon University, 2018). Data custodians can be part of a platform owner company or externalities. For example, company SAP provides data custodian services (SAP Finland, 2018).

A data aggregator collects, aggregates and repurpose the data from different sources. They search and try to find correlations from the data as well as visualise complex relationships. The aggregated data is supplied for companies as value-added service like transaction volume or statistics on demand. Price comparison services are the most common example of data aggregators, such as Expedia. (Thomas and Leiponen, 2016)

Provider

Platform providers are interfaces for platforms such as mobile devices are providers for Android. Providers have also power to influence on the other actors. They can become depletive or even start to compete with the platform owner. For example, Netflix has control of its consumers' access to the content of the platform, and it can affect the owner by extracting value from the platform. (Van Alstyne *et al.*, 2016) Additionally, the provider is responsible for the architecture of the platform and can influence the attractiveness of the platform such as design and visual parts. The owner company of the platform can acts also as a provider. (Eisenmann *et al.*, 2008) The platform providers provide a device or service through which other actors can use the platform. Säynäjoki et al. (2017a) proposed that provider as in the form of a smart building with sensors and other internal network connections can act as a data supplier.

Complementor

Platform complementors develop and provide additional complementary assets, e.g. services or products such as apps for Android. Platforms can limit the freedom of complementors or encourage them for innovation. (Van Alstyne et al., 2016) They create value outside the platform and have enabled companies like Google or Apple to grow fast (Wessel et al., 2017). If there are strong interdependences between the agents due to cross-side network effects in platform ecosystem, complementors may need to begin product sequencing with the platform owner and new complementary assets must be consistent with each other (Helfat and Raubitschek, 2018).

Existing complementors can also create entry barriers for other complementors. For example, popular accommodation providers at Airbnb who have a good reputation in the platform success better compared to new accommodation providers without any customer reviews. New entrants may have a hard time to compete with them for customers. (Wessel et al., 2017) Kapoor and Agarwal (2017) argued that complementors who have more platform-specific experience such as developing apps for iOS have a higher impact on their ability to maintain superior performance in platform's ecosystem compared to complementors who have greater general experience. With a platform-specific experience

its easier for complementors to predict how the market perceives the products or services and how to compete with other offerings on the platform. Also, the complexity of platform ecosystem limits the new entrants (i.e., products or services provided by complementors require a higher number of technological interactions in a platform ecosystem) and hinders them from reaching the level of the leader complementors. (Kapoor and Agarwal, 2017) Complementors require some incentive such as earning financial profits or obtaining valuable data to join and remain on a platform (Helfat and Raubitschek, 2018). As the owner, the complementor can also offer assets as a freemium and premium ways.

According to Säynäjoki *et al.* (2017a), complementors can act as data suppliers, data managers, service providers or application developers or sometimes mixed of these in the context of data commercialisation. As a data supplier complementors can provide or sell raw data related to for example the service frequency or user's behaviour of which platform collects. After providing some data free of charge, the data supplier can require a premium allowing to access more detailed data. Data managers improve and clean the raw data converting it into a form that is easier to understand and utilise for analysis. An example of this is a transformation of information or translating a language into another language. Service providers offer new data-based services such as providing the data at the right time for a specific purpose or generating predictive models based on data history. The application developer designs and builds tools to analyse data such as visualisations and mashups. (Thomas and Leiponen, 2016; Säynäjoki *et al.*, 2017a)

User

Van Alstyne et al. (2016) defined a platform user as a "consumer" referring it to a "buyer" or "user of the offering" of the platform while Rayskin (2017) used the concept of "customer". Both concepts of "buyer" and "customer" indicate users that are facilitated by a financial transaction platform. Whereas concepts of "consumer" and "user of the offerings" do not necessarily indicate a financial transaction. The subject to the transaction can be something like information or service-for-a-service. Users have a significant impact on internal network effects on the platform and the success of the platform as discussed at the beginning of this section. Besides taking advantage of the platform content, users can also create value to platform acting as a data supplier where the users produce for example location data or behavioural data (Thomas and Leiponen, 2016; Säynäjoki *et al.*, 2017a). Other actors of the platforms can offer incentives for users to create new value streams or strengthen existing ones. For example, travelling companies can organise a lottery where the price is a certain amount of travelling money and customers submit footage of their trip for marketing material are eligible to participate.

Users' freedom to exchange assets and get involved in content production on the platform is depending on the openness of the platform. For example, the content produced by other users such as reviews or feedbacks build a more reliable picture of the service or product and encourage other users to try out. Another example of a fully open platform for users is Wikipedia, where users can produce content, but the owner needs to supervise the quality of the content. (Parker, Van Alstyne and Choudary, 2016, p. 149-151). In this instance, the user has got some characteristics from another actor, complementor. Joining the platform may be free or chargeable for the user (Thomas and Leiponen, 2016). If the compensation for joining the platform has not been subject to a financial charge, usually the user agrees to give away some personal data.

2.1.5 Platforms in construction and real estate industry

As introduced, platforms are ecosystems which facilitate interactions between platform actors, and they are not necessary only intangible software but sometimes have also physical elements such as hardware. Since the construction and real estate industry is the beginning of the revolution of digitalisation, there are not many platforms existing yet in the industry. However, the ecosystem as a concept has been studied, and its applicability to the construction industry context has been examined through cases seeing a positive relevance for the industry in future (Pulkka *et al.*, 2016). On the way to the digital revolution, first, need to reach digitisation and then move towards to digitalisation (Nölling, 2016), where the construction and real estate industry is now taking its first steps on implementing digital solutions.

Cities and inhabitants produce a significant amount of data that could be capitalised and exploited the development of the built environment. Smart cities rounded by technological solutions enhance the ability to transform social practises and data from the built environment in order to produce value. This opportunity has perceived in the national and global level, which has caused platformization to become a strategically important area supported by cities and the European Commission (Anttiroiko, 2016; European Union, 2018). Smart city has several definitions in the literature that slightly differ from each other. It can be defined as follows: smart city is a multi-dimensional and complex urban development model where new technological solutions and advancements are utilised for enhancement of collective intelligence, and strategical capabilities to improve competitiveness, effectiveness, economic and environmental sustainability as well as enhance quality of life in an urban environment (Dameri, 2013; Angelidou, 2014; Anttiroiko, 2016).

Urban city platforms are created to support urban revitalisation and economic development as well as democratic culture. These platforms are under the city's governance or integrated with city governments and aim to contribute to the success of local businesses and increase the level of employment. The increasing number of living labs in the public sector and government-sponsored innovation platforms attract innovative companies and developer to develop products and services even further bringing also complementary assets to market. (Anttiroiko, 2016) Anttiroiko (2016) studied city platforms in major cities of Finland disclosing the importance of platform openness and residents' involvement and participation role in innovation as part of a developing process of the urban area. Participation level of a citizen may vary from user involvement in product or service development by understanding the users or context of use to citizen rights making initiatives and expressing their interest or concerns in open platform. However, if the practices of an open platform are extended to the city level, the role of the user becomes more unclear between a resident, a community member and political actors that results in the city to look like a living lab or an extended platform. Smart Kalasatama as a sustainable smart neighbourhood, Stardust project in Tampere as part of international smart city project, Helsinki Region Infoshare as free databank of public data, Open Finland Challenges as innovation contest, Open Ahjo as accessing interface for documents of the city of Helsinki, and government's supported KIRA-digi innovation projects to name a few of projects and programs that support the development of a smart city. (Anttiroiko, 2016) To sum up, in an open city platform governed by the city government information is shared, value and innovation are co-created with users and third-party complementors with an aim to build a sustainable and prosperous urban area.

One embodiment of digitalisation in the industry is smart buildings. (Säynäjoki, *et al.*, 2017a) A smart building refers to a building that integrates and accounts for the entire building system with physical materials, intelligence, enterprise, construction and control aspects that are implemented individually. Moreover, the building has an adaptable building system in order to meet drivers for the development and progression of the building such as energy and efficiency, durability, sustainability, comfort and satisfaction. The vast amount of information available from the building system allows adaptability and enables the smart building to prepare itself for local requirements and change over time. (Buckman, *et al.*, 2014) The benefits of intelligent buildings are mainly focused on the post-construction period, i.e. the operating phase. Smart buildings tend to bear the Internet of Things (IoT) solutions that regulate physical systems and collect data, these are for example sensors, actuators and technology that enables physical objects to utilise internet for data communication such as thermostat control, lightning optimisation or tracking system (McKinsey & Company, 2013, p. 52-53). In this research context, the smart building itself acts as a platform with physical elements.

Aggregating and analysing several individual data streams of smart buildings has the potential to benefit firms, space users and owners of the building (Säynäjoki *et al.*, 2017a). By controlling the operational systems of the building and setting them to operate efficiently, the owner decreases the operating expenses of his property (Deloitte, 2016). Säynäjoki et al. (2017a) proposed that users could be for example residents, consumers or employees, the ones who use the building. The sensors can gather data from location or behaviour of space users from which the owner of the building or service provider would get to know what kinds of meeting rooms or working spaces are most in use and what type of spaces have the lowest utilisation rate (Deloitte, 2016). This kind of information helps the property owner to optimise space usage and meet the needs of tenants better. Pleased tenants are willing to stay longer and pay higher rents. Besides this, the IoT -services in retail properties can be utilised for improving customer experience providing targeted offers, information about products or guidance and collecting data from the customer's point of interest to improve for example the store-mix in shopping centres (Deloitte, 2016). Furthermore, Deloitte (2016) argued that someday in future Internet of Things will have an equal impact on the value of the building as location.

Another digital solution is Building Information Modelling (BIM) used in the construction phase of buildings. BIM is a Computer Aided Design (CAD) based 3D modelling technology presenting a visualisation of a building that contains data attributes of objects and helps construction companies for project scheduling, minimise planning errors, risk analysis and estimation, and better facility management (Tekla, 2018). In construction site blue collars, overseer workers and project managers are examples of users of BIM and the program is already used by several construction companies and the number is increasing. BIM contains much information that is shared with many project stakeholders. Gradually, BIM has also become supporting part of the marketing material of residential properties enabling a buyer to experience completed space through 3D-renderings while it still is in construction (Skanska, 2017; YIT, 2018). Furthermore, new applications are developed to extend the use of BIM to the part of the property's service life and facility management (FM) operations. Kelly et al. (2013) suggested that integrating BIM into FM improves the accuracy and availability of FM data and the efficiency of work orders execution. One significant challenge of the integration is an allocation of responsibilities, ownership of data and the

limited compatibility of these two programs (Kelly *et al.*, 2013). The integration would be beneficial for property owners in terms of economic savings and more efficient maintenance. For now, BIM as an information platform supports construction projects and brings together different parties involved in a construction project. However, the program is still developing, and there are many value-generating sources to be founded and new value streams to be created.

While the programming skills of people have developed and digital tools have become more accessible, the number of start-ups in the construction and real estate industry has risen. New applications and platforms have been constructed, piloted and targeted for different user groups. Government's supported KIRA-digi projects are good examples of recent innovation. New IoT and other property technology solutions strive to improve property safety, utilisation, and optimisation of operating and maintenance systems by taking advantage of the building's data. Real estate transaction, leasing and portfolio management platforms are developed for real estate owners to enhance their work. (KIRA-digi, 2018) Transaction and portfolio management platforms are for example RealXpro and Assetti of which KTI combined with the new interface (KIRA-digi, 2017). For space users' new location-based floorplan platforms are developed, and property related information is transformed into a form that it is easier to understand and use. Additionally, new architectural and technical planning related platforms and virtual models are build up to improve working efficiency, accuracy and project management in construction sites. (KIRA-digi, 2018)

To sum up, there are already several different platforms with different levels and scales in the construction and real estate industry. Many start-ups have developed platforms for a particular user segment and a specific need. In most cases, platforms are aimed to transform existing work to more efficient, accurate and secure. As can be noticed, the level of involvement of users in each platform differs and retain complexity.

2.2 *New roles of the user*

In literature, there exist different terms to describe the actors of the platform, especially the role of the user has found to be multifaceted. Therefore, this section focuses on the platform user and aims to review the role of the user. Moreover, the section explores how the role of the user has evolved from the past to present and introduces new topical terms to describe the role.

2.2.1 The changing role of the user

In the past century, the economy has faced transformation changing from a manufacturing economy to a service economy. The transformation has also impacted on the role of customer. After industrialisation, at the time when goods were manufactured without differentiation, the interest towards services and marketing increased in the mid-to-late 1900s with the new idea of the subject to exchange would be something else than manufactured goods (Fisk *et al.*, 1993; Vargo and Lusch, 2017). This change, from goods to service, has defined as transition from a goods-dominant (G-D) logic to a service-dominant (S-D) logic (Vargo and Lusch, 2004; Vargo and Lusch, 2008).

The main contrast between G-D and S-D logics is the basis of exchange. In G-D logic, the exchange focuses on the operand resources in which an action is carried out. In contrast to

G-D logic, the focus of exchange in S-D logic is on the act of operant resources which act upon other resources. G-D logic considers goods as tangible units of output embedded with utility value (value-in-use) during the manufacturing process and views goods primary in the center of exchange activity. (Vargo and Lusch, 2004; Vargo and Lusch, 2008; Lusch and Vargo, 2006) Vargo and Lusch (2008) proposed that G-D logic services are a special type of good.

Furthermore, the logic regards "services" as (1) a restricted type of intangible goods or (2) an add-ons that add value to good (Vargo and Lusch, 2004; Vargo and Lusch, 2008; Lusch and Vargo, 2006). The term "product" started to be used to include both characteristics of tangible goods and intangible services as a unit of economic exchange. To maximise efficiency and profits, production would ideally take place in separate from the customer and result in standardised and inventoriable goods which are distributed efficiently. G-D logic views customers as targets, isolated entities to whom units of output are directed to and whose role is to consume the value produced by the manufacturer of the good. The value of the manufactured product is captured in this exchange activity through, i.e. price. (Vargo and Lusch, 2008; Kantola and Karowski, 2012, p. 141-142) Thus, the user of the good is not involved in value creation or manufacturing process and is rather destroying the value by utilising the good. However, goods are not itself a reason why consumers buy them, and therefore the logic has some shortages. Goods render a benefit of service, they are inputs into experiences, and besides tangible characteristics, they can also have intangible features associated with for example brand, social connectedness or self-image. (Vargo and Lusch, 2011)

New logic appeared in the literature in the beginning of the 21st century that is well-known in marketing studies. (Danivska, 2018, p.5) While G-D logic viewed units of output as an object of exchange, S-D logic views service as the primary focus of exchange and describes the activity as a "process of doing something for another party" producing value-in-exchange. Instead of producing goods or services for the customer, producer's (firm's) role is to assist the customer in their own value creation process. However, in S-D logic goods can be part of the service delivery, at least as a subset of the economic exchange. Furthermore, service is the application of competencies such as skills and knowledge that are used to the benefit of the other party. The party of service producers can provide the service together with the other party in order to get reciprocal service from the receiving party in the purpose of economic exchange. Therefore, the focus of value creation changes from producer-centric to the collaboration of co-creation of value between the parties. Moreover "service-for-service" indicates that both parties (provider and customer) are value creators and beneficiaries which eliminates the distinction between producer and consumer in value creation. The customers are not seen as targets anymore instead as valuable resources who need to be understood. (Vargo and Lusch, 2008)

Subsequently, S-D logic developed further and emerged with a new perspective of network and actors rather than pre-designated roles of, i.e. consumer or producer. The older version of S-D logic used language that expressed the logic more specified in the firm, customer and managerial terms. (Vargo and Lusch, 2016) Along with an advanced perspective, Vargo and Lusch (2016) proposed five axioms for the foundational premise of S-D logic. Firstly, service is the fundamental basis of exchange, which remained unchanged from the origin logic. Secondly, multiple actors including always the beneficiary participate in value co-creation. Hence, the company makes only value propositions and cannot deliver

value.(Vargo and Lusch, 2016) For example, when buying a car, it does not deliver the value by itself, but the value comes from its use when driving from one place to another. Still in order to drive there needs to be roads, gas, maintenance places and other services which are involved in creating this value. (Danivska, 2018, p. 6) The latter refers to the third axiom, "all economic and social actors are a resource of integrators" which indicates a structured network where the value is created. Fourthly, beneficiary determines the value uniquely and phenomenologically which imply the value is subjective (Vargo and Lusch, 2016). The user determines the value through use that is also referred to value-in-use (Lusch and Vargo, 2006). Lastly, Vargo and Lusch (2016) proposed entirely new axiom for S-D logic stating that actor-generated institutions and institutional arrangements coordinate the co-creation of value. Term "institution" refers to a relatively isolatable and individual "rule" that can be for example a norm, symbol, meaning, law or practice. Additionally, term "institutional arrangements" refers to sets of institutions that are internally related constituting a relatively coherent assembly which facilitates co-creation of value in a service ecosystem. (Vargo and Lusch, 2016) S-D logic has expanded remarkably in past years, and the role of product and service user has changed to actor and emerged in terms of the basis of exchange becoming part of value creation.

Recently, a new perspective, Customer-Dominant (C-D) logic, has developed in Nordics. Heinonen et al. (2010) argue that G-D and S-D logics represent a dominant provider perspective and emphasise the significance of customer perspective, C-D logic. Term customer is not limited only on the consumer but covers the actor, buyer, client, firm, organisation and all type of users who use the offering. According to C-D logic, the customer is the key stakeholder that embeds service in their business. Without a customer, there is no business for a producer. Heinonen et al. (2010) proposed that the focus of C-D logic are the activities what customers do with services and how offering (service or product) is related to their life and assists to accomplish their goals. The service situation becomes the first moment of the company when a customer's participation and use of the company's service engenders a service experience and hence an experience of value. Customer form value from interactive preference experience where the customer uses all current and remembered inputs including cognitional and emotional perceptions. (Heinonen *et al.*, 2010)

Heinonen et al. (2010) studied the cornerstones of S-D logic, co-creation, value-in-use and customer experience through lenses of C-D logic. While Vargo and Lusch (2016) propose that co-creation of the value is essential factor of S-D logic, Heinonen et al. (2015) challenges this by representing that interaction is only one feature enabling provider to influence on the constitution of customer's value-in-use, and thus co-creation gives limited insight into customers' value formation when merely some of these interactions are co-created. According to S-D logic, a customer is always co-creating the value with the company, but C-D logic presents that value emergence is not necessarily resulted from co-creation. Additionally, co-creation depends on that is the customer interested or willing to participate in the company's offering. The customer has more control in service situations than in the dominant provider perspective. C-D logic proposes that the service producer should be involved in part of a customer's life. The logic views customer's value-in-use combination of perceived experience of the company's offering in before, during and after the service, physical and mental activity as well as activities in intersubjective context. The customers orchestrate their experiences and are inseparable from feelings going beyond direct interactions with the service provider. (Heinonen *et al.*, 2010) For example, when buying an Apple-branded phone, besides its technical qualities affecting on product value it

can also have an impact on customer's social status and create a sense of belonging to the user group of the brand. Value-in-use emerges in the customer ecosystem where relevant customer related elements and other actors influence on specific service (Heinonen and Strandvik, 2015).

Users of services or products, i.e. the customers have become more demanding when the competition among the offering providers has increased, and the customers have acknowledged their power over providers. The customers do not so dependent on the particular products as "just a product" like in G-D logic rather they want quality, experiences ("soft values") and tailored service to fulfil their needs. Furthermore, they are more sensitive to the pressure of other users. As can be discovered from the literature, the customer has taken a more central and more substantial role in the service delivery process and service ecosystem as an actor. The role of the company is no longer to control value creation through goods and services but understand holistically the customer who now has the control and create the business strategy around the customer. However, the role of the customer is complex and requires their values to be explored.

2.2.2 User impact on platform value

As discussed, the central element of the S-D logic concept is a co-creation of value through interaction. S-D logic's "service-for-service" indicates that all actors are value-creators and beneficiaries of value, which results in an implication that demand and supply sides distinction vanishes. (Lusch and Vargo, 2006) While C-D logic goes deeper into customers (as "users" in platform context) world striving to understand the role of different activities, experiences and contexts in customers' life. Furthermore, the aim is to understand how service is included in a customer's life and what is the value of service for a customer. (Heinonen *et al.*, 2010)

The value created for a user

But what is the platform generated value for the user and how the user participates on value creation? From a G-D logic perspective, a producer of goods creates value for a user (Business to Customer), and the value creation is more producer-centric. (Vargo and Lusch, 2016) Whereas, S-D logic distinguishes that the producer makes the value proposition for a user and value emerges during the service delivery process (Heinonen *et al.*, 2010; Kuzgun and Asugman, 2015). The value proposition might imply value-in-exchange attributes such as price or product features, as well as value-in-use attributes which include value signs, e.g. utilitarian, hedonic, symbolic and others that could be actualised in use. These two concepts can be recognised to form value-in-context that has "time and place dimensions". (Kuzgun and Asugman, 2015). Kuzgun and Asugman (2015) regarded that the value proposition of a service provider is identified as "service quality", "utility and price benefits", and "service staff knowledge and skills". In addition to functional and emotional elements of value, value attributes that can change lives and have a social impact have also been identified. According to research conducted by Almquist et al. (2016), the value perceived by a customer is one of these four elements or commonly a combination of all of them. "The elements of value" extends Maslow's well-known "hierarchy of needs" originating from the idea that "human actions arise from an innate desire to fulfil needs…" (Almquist *et al.*, 2016). A value pyramid is used to illustrate the powerfulness of value elements, where on the bottom are "functional" attributes, then "emotional" and "life-changing" attributes, and on top "social impact". For example, when a customer regards a bank service as "convenient", the perceived value can

be derived from functional attributes such as saved time, avoided hassle and reduced effort. The study disclosed that the perceived quality of service affects the most customer advocacy and hence it is the most important functional attribute. Emotional values such as wellness, happiness and aesthetic are also important attributes valued by customers. Life changing attributes can be for example self-actualisation, affiliation in a group or motivation. Users of Apple products can experience belonging to the Apple family, and for some, it may be even a status symbol. The highest element on the value pyramid is a value generated by social impact such as a customer's self-transcendence. A shoe company "TOMS Shoes" excels in this attribute, since for each pair of shoes purchased the company gives a pair of shoes for a child in need. Many combinations of these elements constitute the success story of existing products, services and platforms. (Almquist *et al.*, 2016)

Tiwana (2014) suggests that the platform's primary value proposition is its customizability according to users' idiosyncratic needs and it can be expanded with different applications that increase the utility of the platform. Additionally, network effects influence the dynamics of different actors as well as competition between complementors. This can create value for the user by resulting in better offerings in means of price and quality. As in Nintendo's example, when there are more users (gamers) for a console, it becomes more attracting for game developers to produce new games. Almquist et al. (2016) discovered that digital businesses performed better on value than physical businesses. Well-designed digital businesses make user interactions more convenient and fast. For example, Netflix offers a large variety of titles in exchange for the monthly price which is cheaper compared to buying all series and movies in discs. User may experience a nostalgia value from old movies or series that may be hard to find on sale. Moreover, because the titles are available online, the user can choose time and place for watching them and avoid hassle and effort when there is no need to go to a physical store. However, the value proposition is only a proposition until it is actualised in use that is impacted and defined by the user.

The value created by a user

The value proposition forms only a one-sided aspect of the value creation process of the platform because the value is always co-created and impacted by users. User participates on the value creation process which can be defined as a "series of activities performed by the customer to achieve a particular goal." However, the user's ability to participate in the process is depending on the user's amount of information, skills, knowledge and other applicable operant resources. (Payne *et al.,* 2008) If a user does not have the required abilities, the platform's value creation process fails, or the user's actions may turn out to be harmful to the process. User may behave harmfully and obey the platform fighting against it if he feels that the platform is threatening his current position for instance in work life. Airbnb business can be harmful to the neighbours if the travellers are loud or other ways misbehaving. (Parker *et al.*, 2016, p. 231) Although the platform provides tools and information that the user can exploit to fulfil their needs, the actualised value is eventually depending on the user itself.

Several studies have emphasised the importance of committed users that can be exploited to enhance company's service performance by involving users in product or service development (Hoyer *et al.*, 2010; Kaasinen *et al.*, 2010; Haro *et al.*, 2014). The theory of user involvement in service or product innovation has derived from marketing and innovation literature. As discussed Chesbrough (2006) presented a concept of an open business model, where the platform owner seeks new external ideas to improve the

functionality and create more value on a platform. In this context, external ideas would come from the lead user who is involved in the development and innovation process. Buur and Matthews (2008) studied user-driven innovation and user role in part of the innovation process proposing the lead-user approach. 'Lead users' are the users who have more experience and knowledge of singular product or service than average users which could help the owner to meet users' needs better. Generally, they have a broader view of the market condition, leading trends and represent general needs in the user segment. Also, lead users must have the capability, tools, skills and knowledge to advance existing product or services. Companies are seeking this kind of lead users to strengths their innovation processes and find solutions. (Buur and Matthews, 2008) Kaasinen et al. (2010) reviewed the current state of user involvement as part of the innovation process and identified involvement methods in different innovation stages. Furthermore, Fu et al. (2017) disclosed that user involvement and value co-creation varies in different stages on platform evolution. After the platform infrastructure is completed at the emerging stage, the users are involved in co-creation activities such as co-design, co-ideation and problem-solving on the expansion stage (Fu *et al.*, 2017). The user input on the innovation process creates value for the platform and other users.

Users can create value by influencing other users and effecting on the platform's network effects. High perceived value creates a positive image of the service for a user who shares the experience with other users or people he knows that are not yet users of the platform. Uber can create preconceptions among people, since how can you take a ride from some stranger who can be criminal or in the worst case a murderer? If someone you know has used Uber's services before and asks to take a ride together when you have never done it, you feel more secure to do with someone you trust. After the successful drive, the negative preconceptions are gone, and you have created a trust to use the service in the future. This example reflects the value attributes that were derived from literature by Kuzgun and Asugman (2015) to represent the value created at user's sphere: "customer satisfaction", "trust" and "commitment". Satisfied users are more willing to commit to long-term and staying loyal if the relationship benefits them more than termination. Social media and networking sites such as Facebook, Instagram and Twitter provide users with a place to meet other users and groups of users with similar interests. Users themselves create value for each other by using the platform and networking. (Kuzgun and Asugman, 2015)

Users may also produce value by handing over their personal data or data related to service they utilised such as by writing reviews of hotels or service which help other users recognise most valuable services to them as well as service producers to improve their offerings. Additionally, owners and complementors can utilise the data they gather from a customer during and after service delivery. For example, online retailers have data on purchases and customer visitor ratings at sites. (Van Alstyne *et al.*, 2016) With this information, retailers can make recommendations about the offerings that create value for other customers.

Platform's strong performance on value creation attracts and engages more users which in turn attracts more complementors (Almquist *et al.*, 2016). The platform owner needs to recognise elements of value as opportunities for platform growth and choose the right strategy that creates high value for its users and at the same time serves other actors.

2.2.3 Multi-sided roles of the user

During the decade, the user has become more involved in the service process, and the service producer has begun to see the user as a resource of value creation. However, the role of the user has become more complex, and existing literature lacks a broader definition for the user. Therefore the role will now be examined on the basis of the literature presented above.

Section 2.1.4 introduced the four most common actors on a platform and the fact that there are several synonyms for these actors across the literature. For "user", there was identified five different synonyms meaning fundamentally the same. According to Heinonen and Strandvik (2015) "buyer, payer, and user need not be the same actor, but these different roles can be separate elements of the customer concept". Thus, it is evident that the role of the user is multidimensional. Van Alstyne et al. (2016) state that in some cases the user and complementor may switch places with each other, like in cases of Uber and Airbnb. One day users can ride with Uber and sleep at Airbnb, the next day the user can be the driver and host travellers at the accommodation. Parker et al. (2016, p. 299) named this phenomenon "side switching". Säynäjoki et al. (2017a) agreed with this point of view and stated that the user could also participate on by creating and sharing their knowledge and own content. Furthermore, Eisenmann et al. (2008) even appointed complementor asset providers as "supply-side users" and regular users as "demand-side users", which indicates that complementors are users of a platform at some degree. From this can be concluded that there exist users whose primary objective is to use the platform without generating complementary value, and users who both use and act as complementors.

Many theories introduced in this thesis are from marketing, services and innovation literature. Open business models and innovative concepts have explored from both perspectives of the platform owner and user. The owner's challenge is to find a way to capture value from the network effects and data on the platform. The platform owner can try to enhance platform's performance by analysing markets and users, but the studies have shown that most efficient strategy is to involve the user in innovation process (Hoyer *et al.*, 2010; Kaasinen *et al.*, 2010). A user involvement brings new external ideas that are combined with internal ideas of platform owner resulting superior outcome (Chesbrough, 2006; Osterwalder and Pigneur, 2010). Kaasinen et al. (2010) classified three customer roles on innovation process of offering that regard customer as *a resource* (ideation), *a co-creator* (design and development) and *a user* (testing). Also, they emphasised that knowledge and skills of users vary, which may influence the participation ability and quality of data. Although the "lead users" are the most beneficial ones to the owner, other users can also give valuable contributions to innovation. Not all users want to participate in development and innovation process, which is depending on a user's motivation. (Kaasinen *et al.*, 2010)

According to the research related to social media, most of the users (90%) do not contribute to the process while some (9%) contribute a little, and only a few (1%) of them are the heavy contributors who are active and visible users on the platform (Nielsen, 2006). However, the motivation for contribution does not necessarily correlate with the knowledge or skills of users. "Lead users" with high motivation would be very beneficial for the platform owner, but the involvement of users to enhance platform performance is not always possible or efficient way to solve problems. Data can provide a faster and more holistic overview, while users perspective is subjective and do not represent necessarily the user group opinion. Platform owner can see other actors as passive research objects and use platform data to analyse actors' actions and behaviour to improve the platform performance.

2.3 *The user framework*

This section presents the main findings from the literature and introduces the considered roles for the platform user. After that, the user framework is presented.

2.3.1 Findings from the literature

Many studies have explored the platform ecosystem, value creation and value capture while only a few have concerned the platform actors. Four roles of platform actors were identified that included platform owner, provider, user and complementor. In order to succeed, a platform needs users who also attract complementor product or service providers. As literature review has shown, the role of the user is complex and has emerged during past years taking a more significant role in service and service ecosystem as an actor. Understanding better the role of the user the literature review has addressed studies from information technology, marketing, innovation, services and business management.

Based on the literature of the network of actors, there are streams of value and data, and cash flow between actors on a platform. One of the platform monetisation strategies is to charge usage fees from platform participants. The strategy can be charging only the complementors and giving free access for users or the vice versa or providing free or chargeable access for both. As in example section 2.1.2, the platform connects designers and retailers where retailers are paying a joining fee while designers can create an account for free. Additionally, there can be two versions of the platform depending on its features. A premium version has more features than a free version. A good example of this is LinkedIn. The users who value the platform and are willing to pay for it are more valuable for the platform owner compared to users who are interested in a free subscription. Therefore, users can be divided into freemium and premium users.

A couple of scholars came up with the idea that the user can switch roles with the platform complementor, which is also introduced as “side switching”. Complementor participates on the platform value creation by producing platform content or providing complementary offerings. The distinction between freemium and premium users is that the user intentionally generates additional value for the platform and other users and actors. For example, the users of Uber or Airbnb can also be drivers or hosts for other users. From this, the role of the user-complementor is derived.

The literature review explored innovation literature and introduced a concept of an open business model where a platform owner seeks new external ideas to create more value on a platform. However, the internal ideas can also create value on a platform, but collaboration and sharing ideas with external parties has been found to be more profitable. According to the lead-user approach, some users have more experience and knowledge of a single product or service than average users. They have a broader view of the market condition, leading trends and therefore, they have great abilities to develop offerings of the platform — for example, a trial run of the platform and its features before putting on the market. The idea of the lead-user method is that the company seeks these kinds of users and involve them in the innovation process of the platform core. But what if the initiative for participation comes from a user? Users strive to achieve their goals according to their values, and sometimes this can provide valuable outcomes for platform development. These values can be values from the value pyramid that are related to functional, emotional, life-changing or social impact attributes. The user could be regarded as the owner’s “partner” who is given the name of an

innovation user. Although the literature does not distinctly recognise such a user and provides an only light indication of the existence of the role of initial and active users, it is included in the user framework. Since a lead user and an innovation user represent external ideas on a platform innovation process, internal ideas should not be ignored. Hence, the role of an owner-user is included in the framework.

Other user roles that were considered when defining the user framework were users that are not yet using the platform for some reason. The reason can be that the platform does not create enough value for them to increase interest to join the platform. Another reason can be that they do not have the skills or abilities to use the platform. This is also influenced by the platform requirements for users, or it needs some device to operate. Even if they would like to use the platform, it may be that they cannot afford to buy a device. These users are named as potential users, who have some interest in joining the platform but due to circumstances, they will not. Nevertheless, this user group is more accurate when the platform becomes viable and starts expanding. Therefore, the thesis does not include potential users in the user framework which focuses more on the early stage of the platform development.

2.3.2 The roles of the platform user

The user framework is proposed based on the findings of the literature. The framework includes six main roles for platform user: *freemium user, premium user, user-complementor, owner-user, lead user and innovation user.*

Freemium user primarily uses the platform and its offerings for free of charge. User is not involved in the supply of the platform and does not contribute content. The basic information of the user profile is not regarded as a content contribution, but for example, writing reviews would be counted as content. The role is derived from a platform monetisation strategy where there can be two versions of the same platform, free version with limited features and a premium version with more features. The subject is discussed by Evans and Gawer (2016) and Thomas and Leiponen (2016).

Premium user primarily uses the platform and its offerings for a fee. As a freemium user, the premium user is also not involved in the supply of the platform and does not contribute content. The basic information of the user profile is not regarded as a content contribution, but for example, writing reviews would be counted as content. The role is also derived from a platform monetisation strategy and discussed by Evans and Gawer (2016) and Thomas and Leiponen (2016).

User-complementor uses the platform while being also a complementor for a platform. User-complementor participates on value creation by producing content or providing complementary offerings. The role is mixed of both user and complementor roles and based on the idea of side-switching. The idea of the role was introduced by Van Alstyne et al. (2016) and Parker et al. (2016) on their studies.

Owner-user owns and provides the core offering of the platform and uses the collected data from other actors to enhance platform performance. The role is derived from innovation and open business model literature to represent the utilisation of internal ideas and to counterbalance the roles of lead user and innovation user. The literature theory was authored by Chesbrough (2006) and Osterwalder and Pigneur (2010).

Lead user has more experience and knowledge of single product or service than average users which could help the owner to meet users' needs better. Generally, they have a broader view of the market condition, leading trends and represent general needs in the user segment. The platform owner can involve a lead user before platform emerging stage and test functionality and operations of the platform with the user. Involving a user to the innovation process is decided and chosen by the owner. The role is derived from innovation and open business model literature introduced by Chesbrough (2006) and Osterwalder and Pigneur (2010) to represent the utilisation of external ideas. The role was suggested by Boor and Matthews (2008).

Innovation user is an embodiment of a "lead user" who initially participates on the development and innovation process of the platform while striving to own goals and adhering own values. The user becomes a "partner" for the platform owner. An innovation user helps platform owner or complementors to improve the core platform features from a user perspective by providing external ideas. The role is derived from innovation and open business model literature introduced by Chesbrough (2006) and Osterwalder and Pigneur (2010). Furthermore, the role is influenced by Maslow's "hierarchy of needs" and "the elements of value" by Almquist et al. (2016).

Even though six main roles have been defined for the user, it does not prevent the user from gaining the nuances of other user roles. However, one of the six roles would still be dominant. Figure 6 illustrates how user roles are in respect of other actors on a platform. Freemium and premium users are placed inside the role of the user since their primary role is only to use the platform. User-complementor is between the roles of user and complementor due to the ability to switch sides. Because an owner-user creates internal ideas without collaboration with other actors, the role is placed inside the platform. Roles of a lead user and an innovation user represents the external ideas for the platform innovation process, and therefore, they are placed on outside a platform. An innovation user is slightly closer to the platform since the user can be regarded as a "partner" of platform owner. Later, the thesis explores the applicability of the user framework in the context of the construction industry.

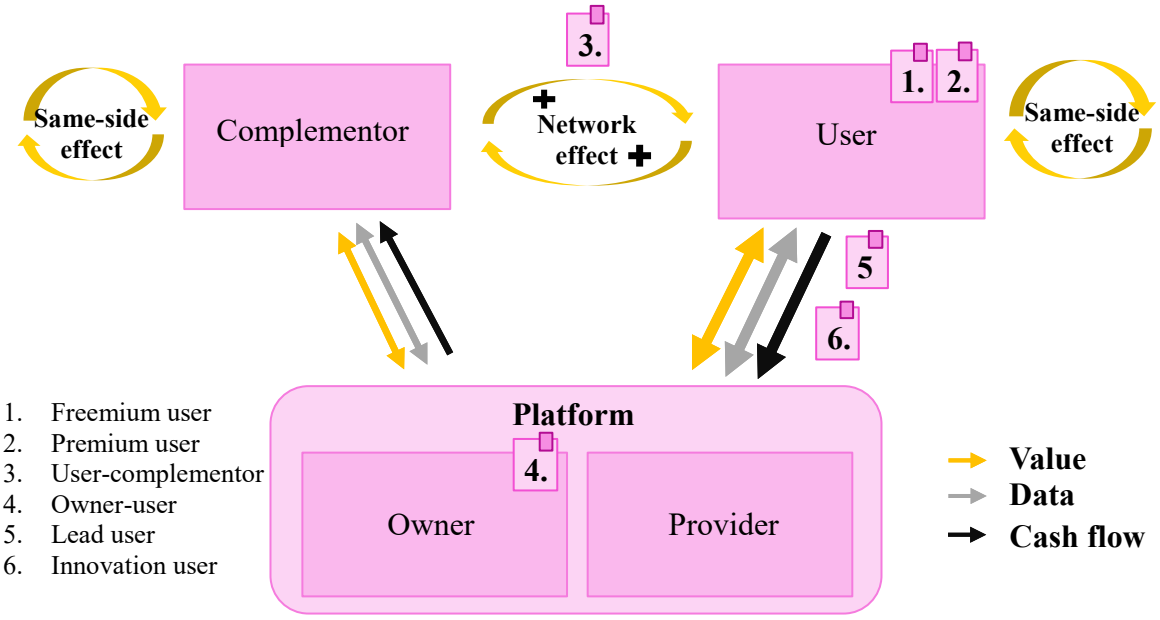

Figure 6 Roles of the user on the actor network.

3 Empirical study methods

The objective of the empirical study is to identify potential user roles on a platform in construction and real estate context. This chapter presents the study process. The first part introduces the chosen study method: a case study. The second and third parts provide a holistic overview of both data collection techniques and introduce the case company.

3.1 *A case study*

The aim of this research is to test a framework that is constructed based on the findings from the literature. Since there exists no equivalent framework in the literature, this research is highly exploratory. The framework is tested with empirical findings from a construction company. The study case of this research is digital models and platforms that are used in the context of the construction process. Construction process covers all phases from planning to handover and guarantee period. Hence, this research is a case study. A case study as a research method can be defined as "an empirical inquiry that investigates a contemporary phenomenon in depth within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident"(Yin, 2009, p. 18).

The method copes with situations of multiple variables of interests that have fewer data points and relies on many sources of evidence. Therefore, the method is used to understand complex social issues. Prior development of theory and its propositions guide data acquisition and analysis. (Yin, 2009, p. 4, p. 18) Yin (2009) presents six steps for the case study process:

1. Planning phase: the research questions are identified, and suitability of the case study as a research method is justified.
2. Designing phase: selecting the case(s) for the study, identifying the case study design and defining procedures to maintain the quality of the case study.
3. Preparing phase: study protocol is developed, a pilot case is conducted, and the study practices and skills are being advanced.
4. Collecting phase: study protocol is followed, the database is created, several sources of evidence is used, and evidence chains maintained.
5. Analysing phase: the evidence is examined, categorised, tabulated and most proper way for analysing is identified in the light of theoretical propositions. The evidence is tested with different techniques drawing an empirically based conclusion.
6. Sharing phase: the results and findings of the study are reported to closure taking into consideration the audience and developing the structure of the report based on others' reviews.

Nature of a research determines a case study design that can be either a single-case or multiple-case study (Yin, 2009, p. 29). The difference between these two designs is that a single-case study concern one bounded case which illustrates the issue under investigation while in multiple-case study multiple cases are selected to illustrate the issue of research (Creswell, 2007, p. 74). A case study is practical when the context of the study is not evident, such as in this study the user role on a digital platform. The context was chosen due to the novelty of digitalisation and its disruptive phase in the construction and real estate industry. Empirical data was collected through a survey and workshops. A case study leans towards

an idea of "individuals" as units of analysis which is also considered to be in the survey. Therefore, this research can be regarded as a design of the multiple-case study.

3.2 *Survey*

A survey is a data collecting research technique which can be conducted as an interview or questionnaire. Interviews are used in qualitative studies while questionnaires are commonly used in quantitative studies. They can be structured, semi-structured or unstructured. Structured means that the questions are presented in order while unstructured is more informal with the question order and has only a few questions. (Creswell, 2014, p. 43, 239-240) The questions are based on a theory, a framework or a model which is tested in the research. The acquired survey data is collected from people, and therefore, it is subjective. The survey is targeted to a wide range of selected population which results in the data can be generalised. (Kraemer, 1991, p. xiii) The participants are selected purposefully to help the researcher to understand the research issue (Creswell, 2014, p. 239).

In the present research, the survey was conducted in the form of a structured questionnaire containing close-ended questions. The benefit of an online questionnaire is that it can be fast sent to a wide range of population who are different places. However, the risk for a low response rate has seen as a disadvantage. (Aarnos *et al.*, 2001, p. 100-102; Hirsjärvi *et al.*, 2005, p. 184-185) Also, this data collection technique prevents the researcher from influencing the respondent, but the researcher needs to minimise the possibility that questions are not ambiguous.

The questionnaire is based on McKinsey's Digitisation Index (McKinsey & Company, 2017) survey that covered sections 2 to 6 that was expanded with data commercialisation and business on sections 7 and 8. Section 1 included background information from respondents such as work position at company, department and unit. Otherwise, the questionnaire was anonymous. The questionnaire was modified to fit better to the construction context and executed with the Webropol -survey tool. The survey was tested first by a test person to see does the respondent understand the survey questions. After modifications, few other people tested the survey as well, and it was modified to be easier to understand. Furthermore, key concepts such as digitisation and digitalisation were explained at the beginning of the survey, and each question has the alternative of "Do not know" for avoiding false results.

The case company is a notable Nordic construction company that builds all kinds of properties and infrastructure. The survey was sent to selected employees at the case company in Finland who presumed to have more knowledge about the digital issues in the company. Since the questionnaire was sent by a member of the executive board of the case company, a large number of responses were received. The broad questionnaire was sent to 90 employees of which 58 responded on August 2018. As can be seen, the respondent rate is relatively high (64%) and provides much data to explore. The questionnaire was sent to selected subcontractors that included construction material and element suppliers, and component producers. Altogether the responses were received 27. Additionally, the questionnaire was sent to selected client cities of the case company that consisted of five major cities in Finland. The questions relevant to this research are presented in chapter 4, and the key findings of the results are discussed in chapter 5.

Thus, the results are interpreted qualitatively, the questionnaire was quantitative by its nature, and the data is analysed on tabulation in Excel. The response alternatives were graded according to the extent that was possible and grading based on how much the alternative supported the measurement of digitisation and digitalisation. The grading was made from 1 to 5, where one refers to low and five to high digitisation and digitalisation level of the company. Nevertheless, this study focuses only on six individual questions from the survey and regard the results of the workshops as a primary data source.

Survey questions
The first and second survey questions are selected to illustrate the current situation of digital tools and systems at the construction process and the use-phase of a building. Since the digitisation and digitalisation can be complicated topics to understand, the questionnaire provides alternative answers. The purpose of these questions is to create a reflection on what kind of platforms there could be, and what are the applications that companies already using. Additionally, on what context they are using these applications. This gives a good starting point for workshops to innovate potential platforms for the industry.

The third and fourth questions are derived from the concept of an open business model where innovation can be a result of internal or external ideas. The third question measures how much the company of the respondent collects and uses data for internal purposes. The question is selected to explore whether the role of owner-user is recognisable supporting the existence of the role. The fourth question explores the attitude of the respondent's company to share data and collaborate with external parties. The purpose of this question is to explore the existence of the roles of a lead user and an innovation user.

The fifth and sixth questions inquired platform actor roles are considered attractive for a company's business. The fifth question represented options regarding the four main platform actors while the sixth question addressed the six sub-roles for platform data commercialisation. The purpose of these questions is to identify if the findings from workshops differ from the broader view of respondents.

3.3 *Workshops*

Workshops can be regarded in means of scientific research as "group interviews" which are unstructured and have open-ended questions. There are only a few questions that intend to elicit opinions and views from the participants. During the group interview, qualitative audio or visual materials may be collected (Creswell, 2014, p. 239-240). The researcher is present during the interview and gives very little guidance during the session ensuring that the discussion is in line with the given theme. The group is composed of participants who are known to have expertise on the subject and from whom can be expected to have an impact on the subject under research. The size of the group is recommended to be from 6 to 8 people. A mission has been set for the group which can be exposing the needs or development of new ideas or operation. (Hirsjärvi and Hurme, 2001, p. 61-62). One target of qualitative research is to increase awareness of participants during the interview session which may require several meetings with the group (Hirsjärvi and Hurme, 2001, p. 102-103).

In this study, the participants were selected by their expertise and potential ability to influence on the issues inside the case company. To every workshop participant was sent the questionnaire; hence they had the opportunity to familiarise themselves with the subject in

advance. The workshops were arranged in Autumn 2018, and the number of participants in the workshops varied between 10 to 16. In order to ensure an equal knowledge between participants, theory related to digital business models and platform was introduced at the beginning of the first workshop. The results of the case company's questionnaire were also presented in this workshop to make the discussion topic more familiar and get more informative answers for the results from respondents. At the second workshop, the results of the questionnaire pointed to the subcontractors and cities were introduced to participants. The third workshop was again arranged with the case company participants while at the fourth workshop also participated people from a major city in Finland.

Due to a number of workshops, not all the participants could participate in every workshop, but most of them attended to them. The number of participants varied and depending on the situation the participants were divided into two groups during the tasks. The workshop tasks concerned the roles of the platform, value creation and value capture. The aim was to develop platform-thinking further during each workshop and innovate new platforms for construction and real estate context. The workshops were arranged on once per month between August and November 2018.

The group interviews were audio recorded and the results documented. During the tasks, participants were asked to write their ideas on post-it notes and categorise them by subject. The results of the workshops were documented and summarised which four researchers went through complementing them. This reduces the risk of the researcher's subjective perceptions of the results and gives a broader view of analysis.

4 Findings from the empirical study

In this chapter, the results of the empirical part are presented and summarised. First the results of the survey are provided, and secondly, observations and findings from workshop tasks are presented.

4.1 *Survey: digital platforms and actors*

The six-question survey explored existing platforms and roles of actors in the construction and real estate industry. The survey was answered by the case company (n=58), its subcontractors (n=27) and client cities (n=5). Questions from one to four address on which areas platforms are being developed and for what purposes are the platform data used. The fifth and sixth questions explore what platform roles the companies of respondents experience the most attractive ones. The results of the survey are discussed at the beginning of the first and second workshops to discover the reasons behind the results.

1. Digital tools and platforms as part of a construction process

The question measures how widely digital tools and platforms have been implemented into the construction process. Blue collars, workers, project management or material suppliers were recognised by the workshop participants to be users for these kinds of platforms. As part of the construction process, the case company uses digital access control and digital working instructions on several sites. However, 3D information modelling, real-time site monitoring and tracking, tracking materials and resources are only in-use on some individual sites. Subcontractors got similar results with the case company.

Cities got quite similar results, but the biggest difference was that they had made try-outs on adding virtual reality to some individual projects while the construction companies seem to not using it. As can be seen from Figure 7, the results indicate that there are few platforms in relatively widely used as part of a construction process, but mainly the platforms are still in the experimental phase or not implemented. However, the pilots show that the industry is acknowledged the benefits provided by the technology. This points to the direction where the industry has started to develop.

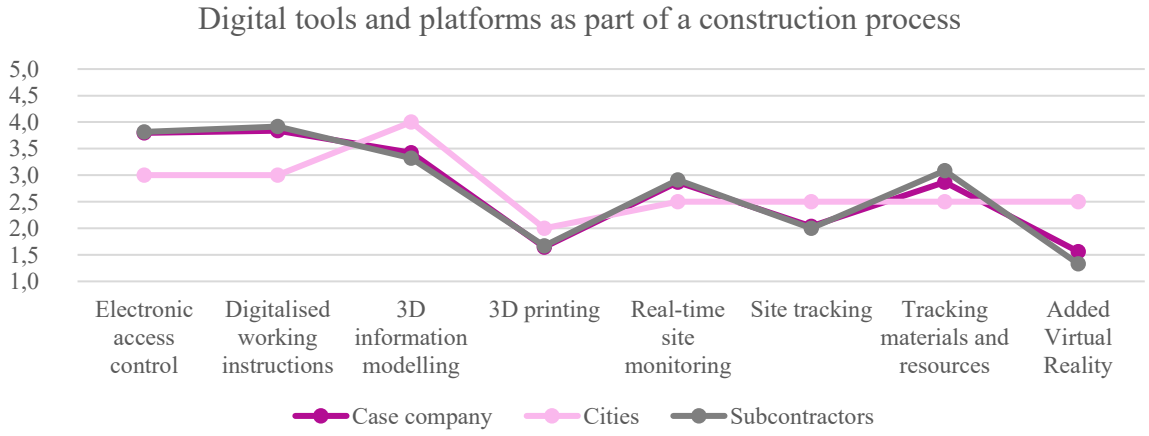

Figure 7 Results – Digital tools and platforms as part of the construction process.

1 = not in use, 3 = used in some individual sites, 5 = used in several sites.

2. *Company involved in the production of smart building services for use phase*

The question addresses if the company represented by the responder is involved in the production of smart building services for the use phase of a property. The purpose of this question is to explore how well the case company and cities have considered smart building services for property users on the use phase. The results between the case company and cities are similar, but the latter seems to focus more on control of energy consumption. The results in Figure 8 imply that many smart building services have been piloted or taken in use in some individual sites. Indoor sensors that measure light, temperature, movement and moisture, and charging stations for electric cars are most widely produced smart building services though they got just slightly higher results than other attributes and are used only in some individual sites.

Subcontractors results on other attributes than "User Interface for user involvement" are significantly lower compared to the results of the case company and cities. This indicates that the subcontractors do not produce smart building services and they are more involved in the construction phase. Hence the result is reasonable because the subject is out of their core business. The overall result shows that also the smart building services are the subject of interest and many services are already piloted in some individual sites. The workshop uncovered one reason why the industry is lagging in technology and digitalisation compared to other industries. When the market is heating up, and economy performs strong, then the main focus is to build more and the focus on training their employees for new working ways or investing in the development of current activities. The past years have been good years in the economy, and the focus is directed to make money.

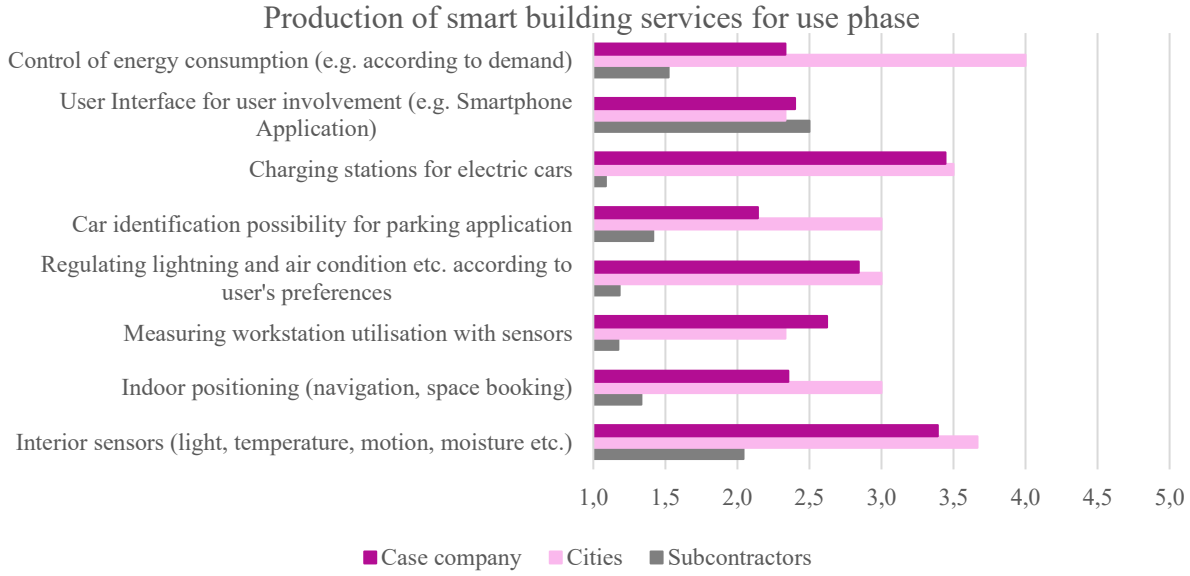

Figure 8 Results – Production of smart building services for the use phase.

1 = not in use, 3 = used in some individual sites, 5 = used in several sites.

3. *Data utilisation for internal purposes*

A property produces a considerable amount of data on the operational phase such as the utilisation rates of spaces and operating costs from water, energy, cooling. The purpose of this question is to find out what extent the building data is collected and used to improve properties performance in future construction projects. Another purpose of this question is

to examine whether the role of the owner-user is possible. The results in Figure 9 show that cities have noticed the affordances of property data and they have tested and used the data more widely than the companies in the construction industry. The case company seems to have minor interest in property data collection but gives slightly more attention to cost efficiency compared to other attributes. The presenters of the case company disclosed at the workshop that the company has lots of data, but they do not know how to take advantage of it.

The results of subcontractors are similar to the results of the case company yet the focus on the internal product or service development is a little bit higher. The low results of construction companies can be explained by the fact that the question focuses more on the use phase and not directly to the construction and planning phase of which the companies are more involved. The workshop revealed that after the hand-over of the building the constructor has no influence on the property which makes the data collection difficult. However, the constructor has responsibility over the building's warranty period and could negotiate contracts that allow them access to property data. General opinion at the workshop supported the idea of building's data collection in order to improve construction performance, which strengthens the proposition of owner-user role.

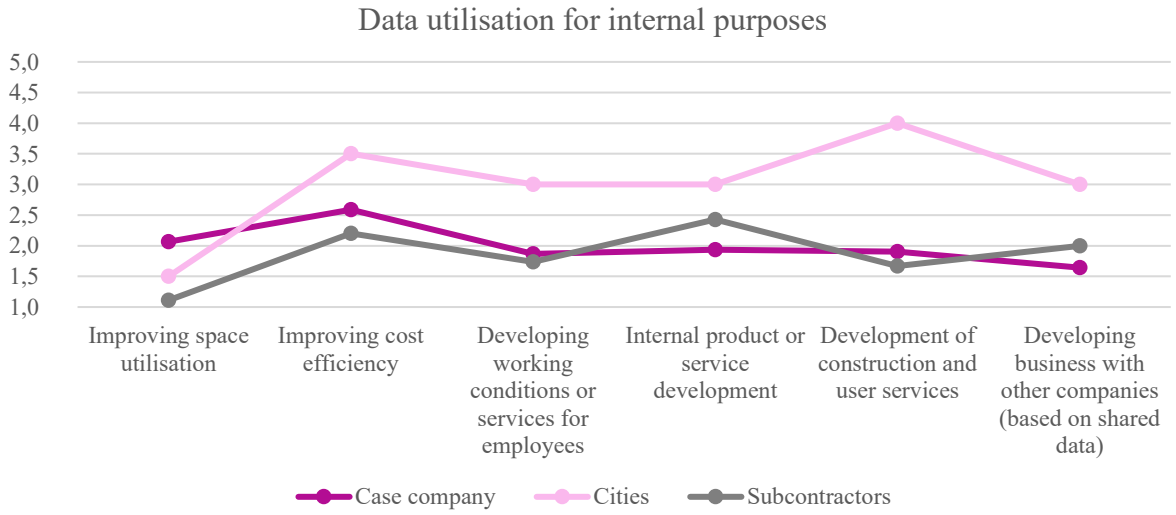

Figure 9 Results – Data utilisation for internal purposes.

1 = not collected, 3 = tested internally, 5 = widely used internally.

4. Data sharing with external parties

This question is based on the previous question taking a more in-depth look at collaboration with external stakeholders in order to improve property performance. The question explores what extent the property data is collected and used with external stakeholders or parties. Attributes under consideration are the same as in question three: improving space utilisation, improving cost efficiency, developing working conditions or services for employees, developing internal products or services, developing construction and user services, and developing business with other companies. The answer alternatives were "not collected", "collaboration with property development stakeholders", "collaboration with customers, users and service suppliers" and "both two previous alternatives". The scale is from one to five where one implies that the data is not collected and five indicates that data is widely used and shared with external parties.

Approximately 60% of the respondents of the case company were unable to answer the question. The 26% of the case company respondents regarded that data generated in the building's use phase is not collected for collaboration purposes with external parties. Moreover, approximately 8% regarded that the data was used in collaboration with property development stakeholders. As can be seen from Figure 10, the results of cities are slightly more favourable in terms of data sharing and collaboration, but the answers are somewhat equally divided between the answer alternatives. However, the cities had the most interest to share data in order to develop business with other companies. The discussion on the fourth workshop also confirmed this result. The subcontractors' results were nearly in-line with the case company results, and only 1 out of 5 respondents were not able to answer. Half of the subcontractors' responds indicated that data is not collected and shared with external parties in order to improve internal products and services, while another half supported the practice. Results regarding the rest of the attributes were also quite low, and only a few of the individual responses indicated that data was shared with external parties.

Majority of all responses pointed to the fact that data is not collected and shared with external parties for collaboration purposes. Comparison of the results of question 3 and this question revealed that data is more used internally to improve a company's business performance than collaboration with external parties. The workshop disclosed that what comes to the construction industry, the companies are still in silos and there is still quite a journey to change the current working practices. This does not indicate support for the roles of lead user and innovation user to yet exist in this industry.

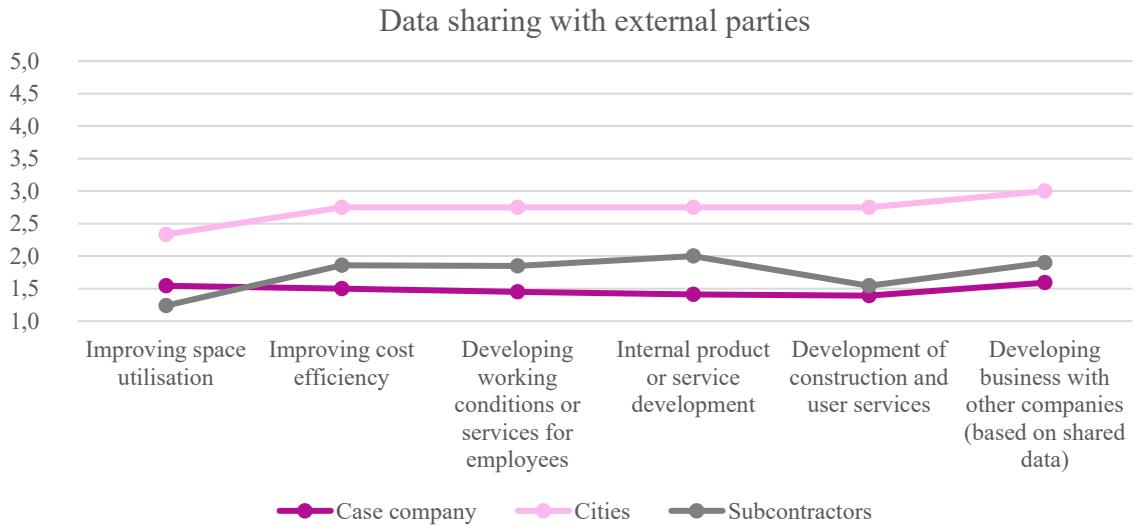

Figure 10 Results – Data sharing with external parties.

5. *Platform actors*

Digitalisation enables a platform economy where a company provides a platform on which other companies (or individuals) can sell their products or services while others buy them. A platform has four main actors that are a user, complementor, owner and provider. The same company can play multiple roles on the same platform and participate in several platforms. The respondents were instructed to select all the roles that are interesting to the company's business now or in the near future. The results are calculated by dividing the number of times the role was selected by the number of respondents. Hence, the percentage

illustrates the share of respondents who regarded the role to be attractive to a company's business. The results are presented in Figure 11.

The case company experienced the role of platform complementor most attractive while a user was experienced as second and owner as third attractive ones. According to the workshop discussion, the reason why the role of platform provider was seen the least attractive was that the company does not have the resources to produce it and it is far from the core business. As denoted in question 3, the case company has much data and therefore, the role of a platform complementor would be a considerable role for the company. Thus, the company got low results on question 4, it does not imply that they would not have an interest in the role that produces platform content. Moreover, the user role was also seen very attractive, which indicates that the company would also like to benefit from the platform data. Half of the respondents of the case company who selected platform user, also selected platform complementor. Selecting both would support the idea of the user-complementor role. Platform owner was chosen 34% and provider 21% of the respondents who selected platform user.

Cities saw the role of the platform complementor the most attractive one. Additionally, they got the highest scores from question 4 regarding data sharing and collaboration with external parties which supports their preferred role as complementor. The results are comprehensible since the roles of platform owner and provider require more resources than other actor roles and are also out of the core business of both the case company and cities. Like everyone else, subcontractors preferred most the role of complementor. Different from other results, subcontractors experienced the role of a platform owner more attractive than the user. However, the role of complementor was seen the most attractive one among all respondents.

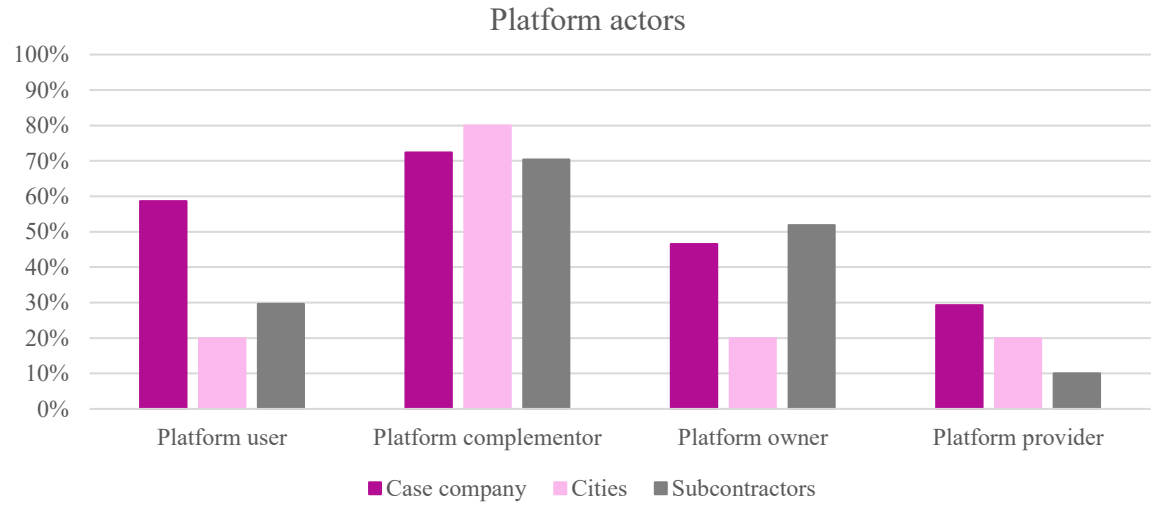

Figure 11 Results – Platform actors.

6. Roles for data commercialisation

Commercial exploitation of data is at the heart of the digital business. The respondents were instructed to select all the roles that are interesting to the company's business now or in the near future. The roles were described as follows for the respondents:

- Data suppliers are organisations that produce data for others.

- Data managers are organisations that categorise, parse and re-structure data that is not in an easy-to-use format.
- Data custodians are organisations that create "trust infrastructure" for the further distribution and resale of data.
- A data aggregator is a specific type of service provider that focuses on data collection, compilation, and customisation, with a particular focus on specific sectors.
- Service providers are organisations that develop data services, typically for data resale, analysis, or repackaging.
- Application developers are organisations that develop, produce and sell applications that enable data commercialisation.

Among all respondent groups, a data supplier has seen the most attractive role in means of business. The results are presented in Figure 12. The case company experienced roles of the data manager, custodian and aggregator relatively attractive while cities saw roles of data custodian and service provider relatively attractive. The results were in-line with the results of question 5, where the most preferred role was complementor. The least recognition got the role of application developer hence it was from subcontractors' perspective equal with other roles excluding data supplier. The reason for this is that the case company or cities do not have adequate resources for developing applications.

Four out of five respondents of the case company who choose "user" or "complementor" in the previous question also selected the role of data supplier. Thus, a complementor generate platform data and use it which support the proposition of a role user-complementor. The results indicate that the represented companies in the survey have the ability to produce and collect data but its processing, re-structuring and development of applications to use data more holistically is not seen as an extensive opportunity to gain extra profits.

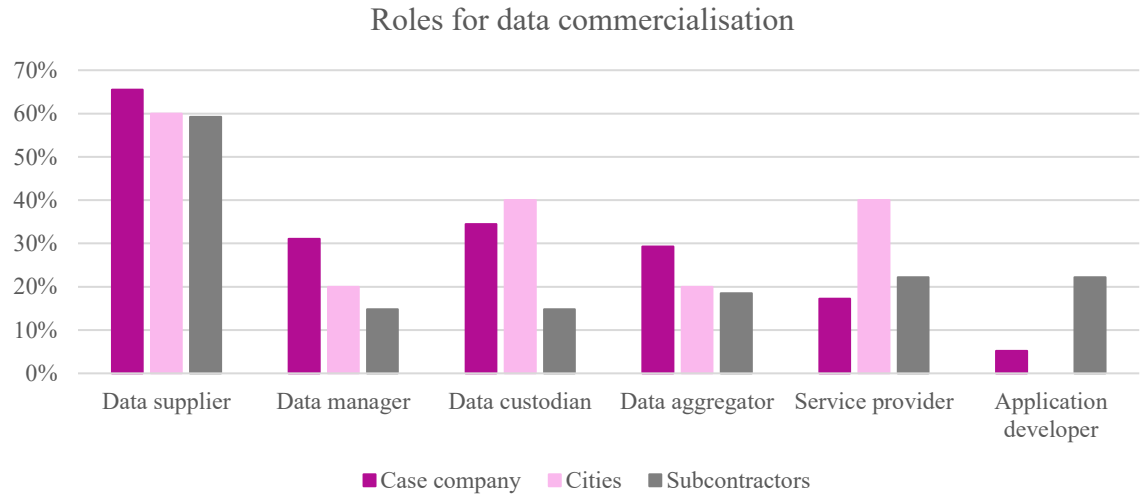

Figure 12 Results – Roles for data commercialisation.

4.2 *Workshops: The user's role*

The purpose of workshops was to research more holistically the platform roles and explore different platform ecosystems in the context of the construction industry. Three different platform concepts were developed at four workshops. Participants were instructed to start developing platform concepts from scratch. In order to create realistic platform concepts, the participants had to consider factors such as where to collect data and how to use it, how to

make users commit to using the platform, what kind of value is being created and to whom, and what share of the value can be monetised? Summaries of the fictional platforms are presented in Figure 13.

A. Project business platform

The idea of the project business platform arose from a need to improve the construction performance on site. The discussion at the workshop focused more on what information would be needed in a construction project to improve current operations and improve the most important metrics: quality, schedule and cost. In other words, the most typical shortcomings in the construction project were taken as an approach. From this, important information was identified to help avoid these shortcomings. The information sources were such as details of different material suppliers (such as delivery status information and performance data), monitoring material, capacity and logistics, and real-time project information for risk management.

The case company would act as the owner of this digital platform, and a third party would take the role of the platform provider. Although at first, the platform would only be for internal use of the case company and the enhancement of the company's operations, the subcontractors and suppliers would be included soon in the platform as complementors. Thus, the case company would also be a user of the platform. Before the platform can be expanded into a general business practice of the case company or offered to subcontractors and suppliers, the owner must first test it internally with some employees and externally with some third parties. Complementors could be for example vendors (product information), architects and other planners (data content), construction element producers and wholesale businesses. It was suggested that some suppliers of the goods and subcontractors could act in both roles of complementor and user as they would enrich the platform by sharing product or service information while also getting information. Besides the suppliers and subcontractors, the platform users could be the people who use the building or are involved in its operation such as property maintenance, building permit and other authorities and users of environment that is close to the property. The platform would develop slowly from an internal tool to a hybrid platform where other parties besides the case company would produce and share data.

B. Connected smart product and service platform

Developing technology has enabled connectivity of different systems and devices which gave the base idea for this platform. Data is flowing more freely and is available to ones who need it. But what data is valuable to whom and why? The first discussion at the workshop addressed how the participants themselves perceive value and how the platform would meet their needs. The value was designated to be related to daily life with several elements such as comfort, without stress, better health and life, more time and money, social sustainability, safety, sociability, sense of community and prevention of inequalities. Eventually, a residential area was chosen as the platform context, and consequently, the inhabitant of the area was determined as the user of the platform. The case company has ownership of the platform and a third-party act as a platform provider. Complementors could be providing complementary services or products for the platform and its users. These could be for example public transport providers (information of schedule and routes), distributed energy resource systems, GSM companies (location information) and service providers that can also target services for a specific consumer group like families with children or elderly. The platform would act as intermediator on the financial transaction between the service provider

and inhabitant who buys the service. One of the platform goals could be selling the cityscape with services of complementors and other partners. Furthermore, the actors could create together a digital brand for a residential area.

The data collected from inhabitants in the residential area could be used to improve the functionality and satisfaction of the area. For example, the point of interests in the area can be determined by locational information. Naturally, the user of this kind of data would be a construction company, but on this platform, the case company acts primarily as the owner of the platform. From demography can be interpreted structure of the population and predicted what kind of residential areas would have demand in future. After construction, the constructor has a technical responsibility for the property for several years, known as the warranty period. During this period the company is linked to the property which was seen as an opportunity to be involved in the resident's life by providing in-house or areal services. Inhabitants would have an application that connects the security system, different household appliances and electronics and enables them to be controlled remotely. The application would also have water and energy consumption statistics, on-demand household services, mutual car and laundry booking systems. The application would be connected to the platform. Some of the information can be collected without the permission of the resident, but to get more data constructor might need to use incentives. For example, to hand over personal information, a discount on maintenance charges could be offered to a resident. Since the case company is the owner of the platform, they would also benefit from data recorded on the platform and application. To sum up, the core idea of this platform is that residents and visitors of the area give permission to collect data through devices and appliances, and in turn, they get something they value.

C. A city block platform

Participants from both the case company and the city of Finland took part in the creation of this platform concept. Since the city was involved in the workshop, the context of a residential city block was an apparent choice. However, it was also suggested that instead of limiting the platform for one block, the platform could be formed for a few other blocks. First, potential users and complementors were identified. Complementors could be producers of daily services and products, energy companies and power plants, waste management providers, mobility providers and residents of the block or neighbourhood area.

Potential user groups for platform could be residents and other citizens living in the neighbourhood, the guests of residents, working people, elderly, families with children, property owners, property maintenance companies, construction companies and City. Eventually, it was concluded that residents of a block would be the main platform users. Inside the segment, there are many individuals with different interests and values. For example, some want to live in an environmentally friendly way, some are interested in financial savings and low-cost living, and some want to influence the services and urban structure of their neighbourhood area. The latter one was named as forerunner residents. Users could be involved and committed to the platform by showing them the benefits of the platform. From the user and complementor perspective, the value provided by the platform could be for example higher sustainability and productivity, the city area as an experience, a neighbourhood brand, enhancement of the community of area by improving areal reputation and safety. Additionally, the idea of pop-up spaces for complementor service providers was suggested, which would bring services closer to the residents. In the case of

the elderly, this was seen very convenient. The platform facilitates the financial transaction of the service between the service provider and the buyer resident.

The platform would be integrated with the block system and is owned by the housing company. The data would be collected from residents and third parties such as utilisation rate from common spaces of the block, consumption data and water meter readings from energy companies, and technical information about the building from the construction company. The platform would enable the connection between the residents creating a more united community. When the residents know their neighbours and can contact them if they want, this enhances a feeling of security and contribute to sharing the economy of the block and a close-up helping hand. The platform would result in energy savings, consumption management, information about consumption spikes to electricity company, cost saving and better conditions for enabling connectivity and collaboration when all the activity takes place in the same platform.

The platform providers would be outsourced. Moreover, the case company remains to be as a constructor, but the platform would make the new blocks more attractive for home buyers. Before a block platform as a concept can be provided to a broader audience, it needs to be tested in a pilot project with pilot block residents and complementors. In order to platform to succeed there need to be enough residents to use the platform and enough complementary service and product providers.

	Project Business Platform	Connected Smart Product and Service Platform	A City Block Platform
Context	Construction and project management on site.	Residential area.	A city block.
Users	Subcontractors, suppliers and property end-users.	Residents and visitors of the neighbourhood area.	Residents of the block, property owners, property maintenance.
Value	Improvements in schedule, cost and quality assurance.	Enhancement of structure of built environment, higher quality of life and health, sustainability and safety.	Communality, reliability, energy and cost savings, sustainability and safety.

Figure 13 Results – Platforms of workshops and the role of user.

4.3 *Results*

In this section, the findings of empirical research are applied to the user framework, and the feasibility of the framework is evaluated.

The literature on platforms revealed that researchers had used different concepts to describe a user on a different context. The concepts of "customer" and "buyer" were used more commonly in a context where the platform's purpose was to facilitate a financial transaction. Then again, the concept of "consumer" was used to refer "users of the offerings" which do not directly indicate to a financial transaction. Other concepts used in literature to describe a platform user are presented in Table 1. The first research question was; how digital platform literature recognises the user? Since there were not many studies about the role of the user on platform literature, the literature review had to be supplemented with studies from other fields. By exploring the literature on information technology and systems, marketing, innovation, services and business management, the user framework with six user roles was proposed: *freemium user, premium user, user-complementor, owner-user, lead user and innovation user.* Detailed descriptions of the roles are presented in section 2.3.2. The identified users from the construction industry are applied according to the roles of the user framework in order to test the applicability of the framework.

The second research question explored how construction professionals perceive the role of the user on digital platforms? The results of the survey disclosed that the need for digital tools and platforms had been recognised and some experiments had been conducted at individual sites. Cities seem to be a bit ahead of construction companies in the implementation of digital tools and platforms at construction processes and use phase of the building. The construction industry has regarded to be in silos, and the results of the survey support this view. The industry is not yet sharing the data and collaborating with external parties. However, it did not seem that the mentality of construction companies was "not invented here" meaning that they do not want to share the data rather they do not know how to benefit from it. According to the overall picture, instead of sharing the data with other parties, companies in the construction industry use data for internal purposes. Cities were more open-minded and willing to share data and collaborate with other parties.

The role of platform complementor was seen the most attractive among the actors of the platform. Cities did not find a user or owner roles attractive while the case company and the subcontractors regarded the roles relatively attractive. Cities seem to be more willing to produce data, provide services and create "trust infrastructure" for data distribution and sale. Whereas companies in the construction industry would both use and produce the data and even take the role of the platform owner. Slightly more than half of the respondents who choose the role of the user also selected the role of complementor. Choosing both roles indicates that there would exist both users who primarily use the platform and users who also produce content on the platform. Thus, some companies would have the role of a user-complementor. The least interest had the role of a platform provider, which is understandable since none of the respondents' core businesses includes this kind of resources. The results indicate that the companies in the survey have the ability to produce and collect data, but processing, re-structuring and development of applications to use data more holistically is not seen as an extensive opportunity to gain extra profits. The results from the survey supported the results and discussions at the workshops. The interest to own and use data internally supports the proposition of the role of the owner-user. However, the current overall

situation on data sharing is contrary that put on a question the existence of the roles lead user and innovation user.

The workshops resulted in three platforms of (A) “Project business platform” for construction site, (B) “Connected smart product and service platform” for residential area and (C) “A City block platform” for residents at the block. The professionals of the industry recognised several platform users from the construction and real estate industry. The users of “Project business platform” would be construction project suppliers and subcontractors, the people who use the building or are involved in its operation such as property maintenance, building permit and other authorities, and users of the surrounding environment of the property. The platform is used for construction project management and includes data related to the project for example details of different material suppliers (such as delivery status information and performance data), data of materials, capacity and logistics, and real-time information of project that can be used for risk management. Suppliers and subcontractors can provide data from their products and performance, but at the same time, they can use the information to improve their service and products. From completed project statistics, they could forecast the number of materials used for a similar project and manage inventory. Therefore, suppliers and subcontractors would be user-complementors of the platform.

Although the case construction company’s primary role is to own the platform, it can also benefit from the data to make better material choices or identify which suppliers perform most poorly and get up-to-date information on the progress of a project. At first, the platform would be developed for the company’s internal use and later open for others. Thus, in the beginning, the company would take the role of the owner-user. Because the platform is piloted and internally used before, it is given to a broader external audience, some of the suppliers and subcontractors would test the applicability of the platform. Hence, the case company would take the role of owner-user when the platform is in internal use, and some of the case company’s suppliers and subcontractors would be lead users for the testing process. When the building is completed, the platform has a considerable amount of technical data about the building. The performance data of the building components and systems can be recorded to the platform, and from statistics can be expected the future renovations and replacement periods of components. This helps to avoid expensive accidents and react in time. Additionally, the detailed information of building structure helps the property maintenance company to know what kind of substitute is precisely needed, and they can also maintain a list of work that is done. Thus, property maintenance would be categorised as user-complementor.

From the authorities need to be requested a permit to do construction or alteration work at the site. Building permit requires additional information about the property, and the platform containing all technical data could be provided for authorities. The occupiers of the building, for example, an office building would benefit from floorplan navigation and space booking system. People who use the area close to the construction site could be offered a virtual illustration and real-time snapshots of the project process. The platform would only give information to authorities and people in the neighbourhood. Because neither of them pays for the right to use the platform, they both are freemium users.

The users of "Connected smart product and service platform" are the primary inhabitants of the residential area, secondary the construction companies. From the people at the area could be collected locational data to determine the area's point-of-interests of which the construction company could benefit from developing the city structure. This platform is owned by the case construction company, who can use the data itself or provide it to other construction companies. Therefore, in this case, the construction companies could take the roles of user and owner-user. However, it was not determined if the area's data would be provided for the construction companies free of charge or not. The platform would be primarily used by the residents in the neighbourhood comprising energy and water consumption information, shared car and laundry booking systems and on-demand house services. Personal information can also be collected from residents with their permission. Since the platform does not allow inhabitants to purposefully produce content on the platform and the data is only collected from their actions, the inhabitants are only the users of the platform. Some platform offerings such as energy and water consumption information would be free of charge for users, but for example, the on-demand house services such as cleaning would cost. This would divide the inhabitants based on what platform offerings they are using into freemium and premium users.

The third platform was named "A City block platform" and limited on a residential block. The main user of the platform would be a block resident. The platform would provide different areal services and technical information of the block such as waste, energy and water consumption. The platform would also connect the residents and create a sense of community which enhances the safety atmosphere of the area. The housing company would be the owner of the platform, and the board members would be at least partly in charge of the platform and its service offerings. For example, the housing company can use the basic information of the residents to target areal services according to residents' profiles or increase the services that are on high demand based on user statistics. The housing company would take the platform role of owner-user. The property owner, property maintenance company and construction companies could use the buildings technical and performance data for their work and update the database. Other suggested users that could be categorised as residents were working people, elderly and families with children. However, inside the segment of residents, there are many individuals with different interests and values. For example, for some, eco-friendly choices are important, for some frugality, whereas some are interested in improving the services and urban structure of their neighbourhood area. The latter was named as a forerunner resident at the workshop and now renamed as an innovation user. The resident can influence the platform features through a housing company by suggesting improvements or improve platform offerings by proposing new services. The connectivity feature of the platform enables communication between residents and supports the formation of a sharing economy. Moreover, residents can ask favour or help form each other. Since not everyone is willing to participate in sharing economy or giving a helping hand, the residents could be both users and user-complementors of the platform. As in the case of platform B, some of the platform services could be free, and some charged which divides the platform users into freemium and premium users. Summary of the empirical results on the user framework is presented in Figure 14.

To conclude, the users found from the empirical study can be applied to the roles of the user framework. This supports the idea of different types of users on the platform and the roles derived from the literature. In the empirical study, roles that were unsuitable for the framework were not revealed. Thus, the role of owner-user was recognised on every

platform, its inclusion in the framework is questionable. In the beginning, the owner-user role was proposed as a counter role for external roles of lead user and innovation user. As discussed in section 2.1.4, the owner makes a strategical decision, controls the openness of the platform and holds rights of a platform's intellectual property. Moreover, the owner has two sub-roles of data custodian and aggregator. There is no actual difference found between the roles of owner and owner-user. Every business owner aims to develop and improve their business performance, and they will use every data that is available to achieve the goal. Therefore, the role of owner-user is replaced by an owner in the final framework presented in section 5.1 Figure 15.

User Framework

Freemium user
- A) Authorities, people at neighbourhood
- B) Inhabitants*, construction companies
- C) Block residents*

Premium user
- B) Inhabitants*, construction companies
- C) Block residents*

User-complementor
- A) Suppliers and subcontractors*, property maintenance
- C) Block residents*, property owners, property maintenance, construction company

Owner-user
- A) Construction company*
- B) Construction company
- C) Housing company

Lead user
- C) Suppliers and subcontractors

Innovation user
- C) Forerunner resident (Block residents*)

**Primary users of the platform*

Figure 14 The user framework applied to the context of the construction and real estate industry.

5 Discussion and conclusions

This chapter discusses the key findings of the study, provides answers to the research questions and compares the empirical findings with the user framework constructed based on the literature. Moreover, the conclusion, the quality of the study and the reliability of the results are described. Recommendations for further research are provided.

5.1 *Key findings of the research*

The goal of this study was to provide a more comprehensive description of the role of the user on digital platforms and refine the concept. This was conducted by addressing the literature and proposing six roles for platform user. Additionally, the purpose was to identify users from the construction and real estate industry and compare these user roles with the roles of the user framework composed from literature. First, the survey was conducted to evaluate the current state of platformization of the industry and familiarise the workshop participants to the topic. Moreover, the survey explored what platform roles the actors of the construction and real estate industry experience attractive and on what extent project data is utilised. The survey was sent to the case company, its subcontractors and client cities in Finland. Then, the primary data of this research were collected from the workshops that resulted in three platform concepts.

The first research question was "How digital platform literature recognises the user?" Due to the lack of literature on digital platforms and the role of the user, the scope of literature was extended to studies from other fields. According to service and marketing literature, the user of the offerings, i.e. customer has become more aware of goods on the market and more demanding. Collaboration on service production with the customer has also become more common. The value world of the user has also changed over time. Compared to the past, soft values have become more important as self-actualisation, happiness and self-transcendence, but they have not displaced attributes related to exchange-value or value-in-use such as efficiency and functionality. Besides enjoying the value generated by the platform, the user can also produce it for other platform actors. However, the user can also negatively affect the value of the platform with their actions.

Additionally, the literature review addressed innovation literature and the concept of an open business model. From this was derived a paradigm that the company's innovation can occur with internal or external parties. Finally, six user roles were proposed: *freemium user, premium user, user-complementor, owner-user, lead user and innovation user.* One user group that was excluded from the framework was potential users who are not using the platform for some reason but would use it if the obstacle preventing them is removed. Potential users could be identified after the launch of the platform. However, this study and the user framework are rather focused on the early-stage of platform development than a mature platform.

The second research question was "How construction professionals perceive the role of the user on digital platforms?" The empirical part of the research aims to answer this research question. The survey unrevealed that the need for digital tools and platforms is recognised by the professionals of the industry and some experiments were already performed in individual sites. Cities are more willing to share the data they own with external parties than companies in the construction industry. This supports the general view that the industry is in

silos. Moreover, cities seem to be slightly ahead in the implementation of digital tools and platforms compared to the construction companies. In the platform business, cities considered themselves to the role of complementor over other roles. Whereas construction companies in the construction industry would both use and produce the data in roles of user and complementor and even take the role of the platform owner.

At workshops, three fictional platforms were invented. In research first, the users from the construction and real estate industry were identified, and then the applicability of the user framework was explored. Table 2 shows the basis and justification on which of the user framework roles were identified from empirical research. Freemium users are users who do not actively produce platform content and do not pay for the platform access or the right to use the offerings of the platform. Freemium users were identified on every platform developed at workshops. Premium users were recognised on two out of three platforms. The difference originates from the platform strategies and value capture between the platforms. On Project Business Platform (A) the value comes from shared data and collaboration that influence the efficiency, schedule and costs of a construction project. On two other platforms, inhabitants of residential area or residents of a block can decide whether they want to use free offerings provided by the platform or buy more exclusive ones. Additionally, the data can be sold to other parties like construction companies who would benefit from it.

Van Alstyne (2016) among a few other scholars proposed the user role of a user-complementor where a user could sometimes switch roles with a complementor. The survey question 5 revealed that half of the respondents of the case company who selected a platform user also selected a platform complementor. Moreover, at the survey question 6, four out of five respondents from the case company who choose "user" or "complementor" in the previous question also selected the role of a data supplier. On the platform (A) the suppliers and subcontractors were proposed as users during the construction phase of a building and property maintenance would be a user during the use phase of a building. They would use the platform data to share and collaborate with other stakeholders and produce up-to-date data. On the platform (C) block residents are the primary users of the platform. The idea was that neighbours could offer a helping hand to each other and participate in a block's sharing economy. The resident can be a tenant of the building, and therefore a separate user group of property owners was proposed. Property owners, property maintenance and construction company, could benefit from the technical and operational data of the block and keep the database updated.

The role of owner-user was proposed as a counter role for external roles of lead user and innovation user. The role was supported by the survey, and it was identified from every platform as a construction company and housing company. A business owner aims to develop and improve their operations in order to make the business successful. The role of a platform owner is similar. The platform owner rules the platform, makes strategical decisions and holds rights of a platform's intellectual property. Furthermore, comparing the platform owner's sub-roles of data custodian and aggregator, the definition of the owner-user role and the results of the empirical research, there is no visible difference found between the roles of owner and owner-user. Therefore, the role of owner-user is replaced by the role of an owner in the framework.

The roles of a lead user and an innovation user are associated with the innovation process, and they represent external ideas. The role of a lead user is recognised by innovation literature, but distinct the role of innovation user is not. The results of the survey did not

support much data sharing and collaboration with external parties, but the perspective seems to have changed at workshops. The construction companies would be more willing to share data if other actors would also do the same and they would get an adequate amount of value back. However, this reluctance does not exclude the idea that the companies would be open for external ideas. Lead users could be suppliers and subcontractors on the platform (A) who would test the functionality of the platform before it goes for extensive external use. On the platform (C) a forerunner resident of a block was proposed as an innovation user. This user would like to influence and improve the offerings of the platform. From here can be noticed that a lead user would be more related to the launch phase of a platform whereas an innovation user is more related to the platform that is already operating and have some users. Although there was not many lead users or innovation users identified, the evidence shows that they would exist albeit only to a small extent.

Table 2 Summary of the research findings.

User roles	Survey	Workshop platforms	Users in the construction and real estate industry
Freemium user		A) Project Business Platform B) Connected Smart Products and Services Platform C) A Block Platform	A) Authorities, people at the neighbourhood B) Inhabitants*, construction companies C) Block residents*
Premium user		B) Connected Smart Products and Services Platform C) A Block Platform	B) Inhabitants*, construction companies C) Block residents*
User-complementor	Q5 and Q6 (+)	A) Project Business Platform C) A Block Platform	A) Suppliers and subcontractors*, property maintenance C) Block residents*, property owners, property maintenance, a construction company
Owner (Owner-user)	Q3 (+)	A) Project Business Platform B) Connected Smart Products and Services Platform C) A Block Platform	A) Construction company* B) Construction company C) Housing company
Lead user	Q4 (-)	A) Project Business Platform	A) Suppliers and subcontractors
Innovation user	Q4 (-)	C) A Block Platform	C) Forerunner resident (Block residents*)

**Primary users of the platform*

The empirical research did not reveal additional user roles for the user framework, but the role of the owner replaces the role of owner-user. Due to the modification, the advanced user framework consists of six user roles:

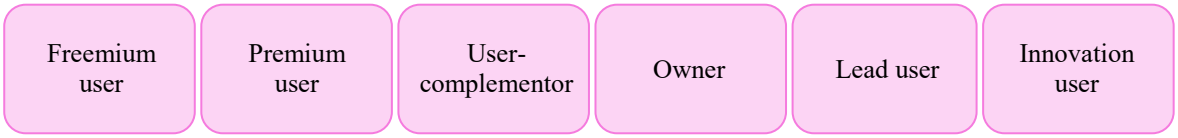

Figure 15 The revised user framework.

As discussed, the role of the user is multifaceted, and the framework is one way to understand it. Users can have many roles, but they have one primary role. A user can have a role that has nuances from another role of the user framework, or it can be a hybrid role. However,

one of the roles still dominates over others. With the user framework, companies can identify different user segments, and determine how these segments are involved in platform and value creation. The platform business strategy would be more straightforward to develop when all the actors are identified, especially users since they are the critical success factor of every business.

5.2 *Research quality and reliability*

The research consisted of the literature review and empirical research. The goal of the literature review was to provide a theoretical background and refine the concept of the user to the extent of the information from the literature. The aim of the empirical research was to identify potential user roles in the construction and real estate industry and test the applicability of the user framework.

The literature review as a research method was considered to be suitable for this study. The purpose of this research was to define the role of the user. However, there was a lack of scientific papers around the topic and the theory need to be looked from another field of studies. This creates a weakness in the user framework of the study, but the theories from other fields are extensively studied, and some scholars agreed with the idea of multisided roles of the user. Typical for engineer sciences is to model, predict and draw logical conclusions for research. Digitalism is a science that falls under engineering and therefore, the study is conducted in an engineering mindset. Thus, this may result in different conclusions compared to studies in other fields of science on this topic.

The empirical part consisted of a survey and four workshops. The respondents and workshop participants were chosen based on their knowledge of the topic. The survey was designed to be easy to understand considering the background of the respondents. In order to avoid false results, on each question, the respondents had an answer alternative to "Do not know". The number of survey respondents was relatively high considering that the research is a thesis-level study. The workshops were experienced as a suitable method to achieve more insight into platform roles, especially the role of the user and clarifying the reasons behind the survey results.

The research used a case study method, and as data collection techniques were chosen a survey and workshops. The most significant concern when using a case study method is that has the research been executed with adequate rigour and have equivocal evidence, or biased views influenced the results. The second concern is that how a case study can be generalised? As presented, this research is highly exploratory, but it does not mean that it is not generalisable. The goal of the research was to expand and generalise existing theories as an analytical generalisation. (Yin, 2009, p. 14-15)

Quality of research can be defined by evaluating its validity. In this research, there are used multiple literature sources and different well-known theories as evidence to form a chain of evidence as a foundation for the user framework. These together build a constructive validity for this case study. (Yin, 2009, p. 41) The collected data was mostly in-line, and logical conclusions could be made. Because the workshops were at some degree based on the results of the survey, the facilitators did not significantly affect the results of the workshops. For avoiding wrong conclusions drawn from the survey, the results were discussed with workshops' participants at the beginning of the workshops. This creates an internal validity for the study.

Reliability measures whether the study can be conducted again by another investigator and can he arrive at the same findings and conclusion (Yin, 2009, p. 45). The framework was constructed on theories and findings from scholars. Many researchers develop and advance the current theories covered in this study. As theories change and knowledge increases the conclusions drawn in the future can be different from this study. Moreover, the empirical research is based on the technological development of the industry which is evolving fast and may result in different outcomes in future. Therefore, the study can be regarded as a snapshot of the construction and real estate industry. The study is highly explorative research that relies on multiple assumptions and time-bound data. However, the research is thoroughly conducted and has justified conclusions. The roles of the user defined in this research might not be the only ones, but they are defined according to the best of this author's knowledge from existing literature.

5.3 *Recommendations for further research*

This study focused on digital platforms and the role of platform user on construction and real estate industry, excluding the users of other industry platforms. Therefore, one interesting topic for future research would be exploring the platform users from other industries and to test the applicability of the user framework. This might reveal new roles for the user or authenticate the framework presented in this research. Since the topic of the research is still novel in a scientific sense, there is still much to investigate.

Currently, the construction and real estate industry has only started to acknowledge the possibilities provided by advanced technology. This means that the industry is still young compared to for example information technology and communication industries in the field of technology and digitalisation. The results of empirical research in this study might differ from the results of future research. Moreover, the study was limited to the country of Finland. If the study would be conducted in other countries, would the results differ or be similar?

There was introduced a user group of potential platform users that were excluded from this research. In order to identify potential users, the platform should be launched and viable. One future research topic would be how to get potential users to join the platform and make them genuine users. Another role related research topic would be user-complementors that have a negative influence on the platform value. This research has mainly regarded the role of user-complementor from a positive perspective.

This study addressed the value created by the user and value appreciated by the user. The purpose of this was to identify what attracts and motivates the user to commit to the platform, and what value the user can produce for the platform and other actors. Further research would concentrate more on the user value on the platform. How the abilities and knowledge of user influence on platform value creation and quality of value? How can users create value for each other and what does it require from a platform? Do users value the value created by other users over the value created by the other actors of the platform?

Also, further research could study deeper the network of platform actors and explore which actors are the most attractive to one’s business and why. In the research respondents of the survey were asked to choose all the attractive roles of actors, but instead of this it would be better if the roles would be ranked.

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